The Electrical World.

Vol. XXIII. NEW YORK, FEBRUARY 24, 1894. No. 8.

PUBLISHED EVERY SATURDAY BY

THE W. J. JOHNSTON COMPANY, Limited,

41 PARK ROW (TIMES BUILDING), NEW YORK.

Established 1874. Incorporated 1889.

Telephone Call: Cortlandt 924. Cable Address: "Electrical," New York.

New England Office, 620 Atlantic Ave., Boston.
Western Office, 936 Monadnock Block, Chicago.
Philadelphia Office, 927 Chestnut Street.

SUBSCRIPTION IN ADVANCE, ONE YEAR, $3.00,

in the U. S., Canada or Mexico; other Postal Union countries, $6.

In requesting your address changed, give **old** *as well as new address.*

Established 20 years ago, THE ELECTRICAL WORLD is the Pioneer Electrical Journal of America, and has well maintained its lead. It has the Largest Circulation of any electrical periodical in the world, and is the Best Advertising Medium.

In the growth of the paper in circulation, size and general improvement, the value of its columns for reaching those engaged in electrical pursuits has not failed to be appreciated by advertisers. The following table shows its steady onward march in this department of business. The first issue of

1880	contained	25	different	adv'ts.	1887	contained	154	different	adv'ts.
1881	"	28	"	"	1888	"	175	"	"
1882	"	45	"	"	1889	"	234	"	"
1883	"	63	"	"	1890	"	289	"	"
1884	"	82	"	"	1891	"	325	"	"
1885	"	100	"	"	1892	"	316	"	"
1886	"	138	"	"	1893	"	317	"	"

The first issue of 1894 contained 320 different Advertisements.

No announcements of the Publisher are included in this list.

THE ELECTRICAL WORLD'S Advertising Rates are much lower than those of any other similar publication, circulation and standing considered, and vary according to space, position and number of insertions. Quotations promptly furnished.

Address and make drafts, orders, etc., payable to

THE ELECTRICAL WORLD,
41 Park Row, New York.

VOL. XXIII. NEW YORK, FEB. 24, 1894. NO. 8.

CONTENTS.

Editorial 233
Multi-Frequency Machines, by Lieut. F. J. Patten..... 235
A Service of Good Will to the Electrical Fraternity, by Allen R. Foote..... 235
A Current Without a Difference of Potential, by O. B. Finn.. 235
A Modified Instrument for the Determination of the ℬ ℋ Curves of Iron, by L. J. Robinson..... 236
Multiphase Motors..... 237
Unipolar Dynamos of the "Inoperative" Type, by Bruce Ford.. 241
A Straight Line Proportion in the Law of the Electromagnet, by Carl Hering..... 239
Formulas for Resistance Coils, by G. Rennerfelt..... 241
On the Design of Electromagnets for Specific Duty, by Dr. Cary T. Hutchinson..... 242
Rope Driving.—IX., by Prof. J. J. Flather..... 244
Digest of Current Technical Literature, compiled by Carl Hering 247
The St. Clair Tunnel..... 251
Street Car Storage Heating System..... 252
Independent Air Pump and Jet Condenser..... 253
New Keyless Socket..... 253
Imperial Dry Battery..... 254
The Empire Street Radial Truck..... 254
Insulator Support..... 255
A Telephone Exchange System..... 255
An Automatic Telephone System..... 256
New Books..... 256

ENGLISH ANTICIPATIONS.

In an otherwise able and interesting paper, descriptive of the electrical industry in the United States, Mr. Preece, of London, makes the following remark, in referring to the World's Fair: "The American public were surprised to find how much we had anticipated their work." We would be interested to know who those Americans were who expressed surprise at the supposed English anticipations, and also what those alleged anticipations were. We can think of only one, and that is the holding of exhibitions, as there were doubtless exhibitions in London before Columbus arrived here, and we do not think the American Indians held any. Probably Mr. Preece's sweeping statement was based on a passing flattering remark made by some Anglomaniac to tickle the vanity of an Englishman.

ECONOMY VS. VANDALISM.

Secretary Carlisle has written a letter to Speaker Crisp recommending that in the interest of economy the electric lighting of the Statue of Liberty, in New York Harbor, be discontinued, claiming that by this means the munificent sum of $9,251 can be annually saved to the government; from which we infer that the epidemic of "peanut politics" has extended from the Senate to the Treasury Department. The apology that the light is no aid to navigation is disputed by mariners, but aside from this there can be no excuse for this puerile attempt to sacrifice one of the objects of the statue in order to save an amount that could, perhaps, be easily economized in the Secretary's own office. Since the Light House Board has joined in this recommendation, it might be well for the New York Congressmen to see if the necessary funds to continue the lighting of the statue might not be economized from the salaries of the officials of this Board.

FORMULAS FOR RESISTANCE COILS.

The formulas and tables given by Mr. Gustav Rennerfeldt in another column will be found in some cases useful for the speedy calculation of resistance coils and the comparison of different materials used for this purpose. The calculations are only for resistance wires, the entire surface of which is exposed and different parts not in contact, so that they would not apply to coils wound in layers on bobbins. The results arrived at are interesting, as it is shown that under the conditions given the weight of different substances having the same resistance in ohms necessary to carry a given current with a given temperature limit are in the proportion, if wires of circular cross-section are used, of 6.53 for copper, 10.5 for iron, 13.5 for German silver and only 2.37 for aluminium, which would make an aluminium coil cheaper than one of German silver and only about twice as dear as one of copper.

MULTIPHASE MOTORS.

In another column we publish a translation from the "Elektrotechnische Zeitschrift" of an important article by Mr. C. P. Steinmetz on multiphase motors. As will be seen, the author makes most sweeping statements, many of which are not in accordance with current opinions. For example, it is stated that multiphase motors can be built equally well and with the same efficiency for 130 as for 30 periods; that variations in speed can be made as wished without affecting the

other properties of the motor; that such motors can be calculated with greater accuracy than even continuous-current motors, and that the starting torque can be even made two or three times as great per watt as at full speed. The criticism of present mathematical theories is also severe. Instead of the self-induction of the armature being made as high as possible, as held, the reverse should be the case, it is stated, while hysteresis has also been improperly assigned a wrong function. The historical resume will be found interesting, as it shows that the principle of the rotary magnetic field was described by Walter Baily in 1879, and points out that multiphase generators were made in 1879 and before. To the list given might have been added the Gramme dynamos, made at the same period as an attempted solution of the problem then popularly referred to as the "sub-division of the electric light." While the opinions expressed by Mr. Steinmetz are in some respects radical, and will probably give rise to discussion, his opportunities have been such as to render him peculiarly qualified to speak on the subject, and there is no doubt of his ability to abundantly defend his statements.

THE SENATE AND THE TARIFF BILL.

We believe we echo the opinion of every one connected with the electrical industries, regardless of their individual opinions as to the economic merits of the measure, when we ask that the United States Senate shall take speedy action, one way or the other, on the tariff bill now before it for consideration, and not repeat the performances connected with the passage of the silver bill, which were as disastrous to the business interests of the country as they were to the prestige of the Senate. During the period when that body was engaged in its extraordinary proceedings over the silver bill, when weeks were wasted in order that the social feature called the "Courtesy of the Senate" might be preserved, business almost came to a standstill, factories remained closed and tens of thousands of people suffered for the necessities of life—all that the Senate might retain its character of what has not inaptly been called "the millionaires' club." As soon as the silver bill passed business at once revived, and were it not for the necessity of awaiting the fate of the tariff bill now before the Senate and, above all, the general distrust of that body and fear that it will again waste months in another unseemly wrangle, the near future would have nothing to fear. The outlook for the spring and summer is bright. The effect of the business depression has been to place the electrical industries on a firm basis. The stocks of manufacturers are low and the deferred needs of consumers large. The number of projects for new street railway, lighting and power plants is very large, as our news columns for the last two months will testify, and if the uncertainty in regard to the measure now before the Senate were removed, electrical businss would probably be affected to an extent that would amount to little less than a "boom." As a consequence we trust that the Senate will this time act more in accordance with the traditions of that once famous body, and by speedy action relieve the present uncertainty and thus enable the business interests of the country to again adjust themselves on a permanent basis.

MISDIRECTED ZEAL.

One of our contemporaries in a series of articles on telephone patents seems to be needlessly subservient to a powerful interest, which probably little relishes the special pleading in its favor in view of the antagonism likely to be aroused through it. The American Bell Telephone Company has always been frank in its business methods, and its more recent action in regard to selling telephones was a notice to the public that its policy is to rest content with a legitimate manufacturing profit on its apparatus upon the expiration of the patents covering them. With its accumulated technical knowledge and great manufacturing facilities it does not fear competition, and therefore is probably not grateful for an advocacy that places it in the light of a monopoly that will brook no rivalry, however legitimate, and one seeking to deter this competition by covert threats. In these articles the intending competitor is informed that the "Bell company should unquestionably be able to make by far the best telephone receivers, through their ability, acquired by long practice, to produce a compound steel magnet of surpassing strength and durability"—a perfectly legitimate claim if made by the Bell company itself, but scarcely so coming from a presumably disinterested source, and in regard to a constructional feature that is generally not thought to involve the superlative skill implied. Perhaps the claim that the Edison transmitter patent has not expired is merely due to ignorance, which, however, would be dense indeed in view of the unbroken series of decisions in favor of the principle upon which its invalidity is based and the weakness of an appeal, which, after over ten years' application of the principle, is only now being pressed to a final decision. The manufacturers of telephone apparatus are informed that if they "will only be as careful and as conscientious in respecting existing telephone patents as are the American Bell Telephone Company and the Western Electric Company, the future of the telephone business in this country will indeed be bright." As the companies named have been supposed to hold the fundamental patents relating to telephony, it will probably occur to the reader that it would have been difficult for them to find an opportunity to infringe, and as the articles in question leave little hope to the intending competitor as to the future, the conclusion he will probably draw is that the advice quoted merely conceals a threat directed at him. The interests so fulsomely lauded are amply able to take care of themselves, and, as remarked before, probably little relish the obsequency of which they are made the object, particularly with a recollection of the sequel to similar conduct in the case of the General Electric Company.

Trolley Balloons.

In a recent issue of The Electrical World attention was called to a novel system of electrical propulsion, which is to form one of the attractions at the exhibition at Antwerp this year. It consists of a balloon, which is to be driven by an electric motor of 125 h. p., the current for which is to be taken from an overhead conductor by means of a traveling trolley. The balloon is to carry passengers to and from the exhibition. It is no more than just to Americans to call attention to the fact that the original invenion was made in this country, as the system was described by its inventor, Dr. W. G. A. Bonwill, of Philadelphia, in a paper read before the Franklin Institute Dec. 16, 1891, a copy of which has been submitted to us.

Municipal Electric Lighting.

Under the auspices of the Philadelphia Nationalist Club a petition is being circulated in Philadelphia asking councils to establish an electric light and power plant, to be owned and operated by the municipality. In the address to the people which accompanies the petition, it is argued that the city of Philadelphia could very advantageously establish a complete electric plant for its own purposes, from which it could light all streets and public buildings at far less cost than the city now pays to private companies for the same service. It could also furnish electric lighting for all private parties desiring it for mercantile and manufacturing establishments and dwellings at a comparatively small cost, and yet with a moderate profit, and electric power for light manufacturing purposes, running sewing machines, &c., the present prices being practically prohibitive in this respect.

Multi-Frequency Machines.

To the Editor of The Electrical World :

Sir—Mr. Arnold's note in your last issue concerning the multi-frequency machine has come to my attention. It deserves notice because there seems to be so much hasty writing of the sort among inventors of standing—writing that leaves the impression that priority of invention is a personal question, rather than one for proper courts of jurisdiction.

Absolute knowledge of priority does not justify the assumption that another inventor may not have independently invented the same thing. It would seem to be so in the present case, for I had no previous knowledge of Mr. Arnold's work. The assertion that I copied his machine is not warranted by the facts in evidence, and I think a little hasty charity might well be mixed with the hasty judgment used in such matters.

New York, Feb. 17, 1894. F. JARVIS PATTEN.

A Service of Good Will for the Electrical Fraternity.

To the Editor of The Electrical World :

Sir—Kindly inform your readers that I will be very glad to oblige any of them in such ways as may be by them desired to make their attendance at the convention of the National Electric Light Association, to be held in this city February 27 and 28 and March 1, enjoyable. It may be especially serviceable to some to have arrangements made for hotel accommodations, for printing cards, circulars, etc., before their arrival. If so, I shall be glad to attend to these and similar matters for them, as an expression of my good faith.

I should be addressed as follows: Allen R. Foote, care the National Statistical Association, Washington Loan and Trust Company Building, Washington, D. C.

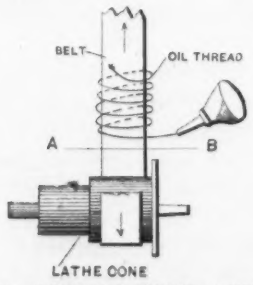
ALLEN R. FOOTE.

A Current Without a Difference of Potential.

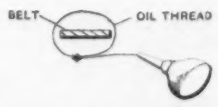
BY OLIVER B. FINN.

The articles on "A Current Without a Difference of Potential," recently noted in The Electrical World, recall an interesting phenomenon, bearing somewhat on the subject, observed a few years ago while studying at the University of Pennsylvania.

On a cold, dry day, while oiling some machinery, the nozzle of an inverted oil can was brought within two or three inches of the ascending portion of the driving belt near the pulley, when a very fine thread of oil was drawn from it horizontally toward the belt and up around it spirally, making about six turns. The free end of the thread was dissipated in the form of a spray, and the flow was continuous for some moments.



ELEVATION OF CONE AND BELT.

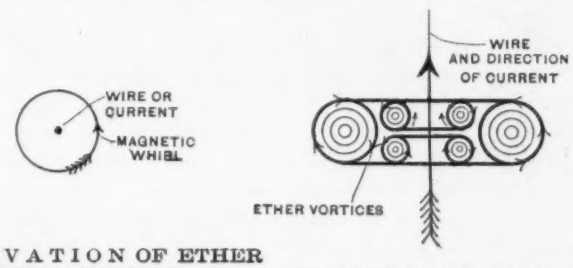


SECTION THROUGH BELT AT A B.

As is well known, on a cold, dry day, quite a long spark can be taken from that portion of a belt leaving a flywheel or pulley. This, of course, is statical electricity. And is not this statical electricity traveling with the belt, a current of electricity, i. e., electricity moving relatively to everything but the belt which conveys it, or a current by convection, instead of conduction, absolutely without a difference of potential? There is no E. M. F. causing flow, and none caused by "an increasing flux." But the charge is gradually dissipated by air convection.

I explained the drawing out of the oil thread to be due to the attraction of the statical electricity on the belt for the induced charge of opposite sign on the oil at the nozzle of the can, but was puzzled to know why the oil did not go to instead of going spirally around the belt. The air current due to the movement of the belt would tend to make the oil rise. But was the circular path of the oil caused by the magnetic lines of force which encircled this, paradoxically speaking, current of statical electricity? Of course the moving of the charged thread of oil produced a second statical current, which should have its magnetic lines of force, the planes of which, in this instance, would be presented at right angles to those of the first. Of the two forces in equilibrium, to produce the circular path, assuming the centripetal to be the attraction of the electricities of opposite sign, what constituted the initial centrifugal force? What prevented the oil going directly to the belt, but forced it to take the circular path around it? Can this be explained by the laws of the magnetic influence of currents upon one another?

Does not this phenomenon indicate that two currents, flowing at angles to one another, first simply tend to direct one another into parallel planes, and until this position is reached resist attraction? If this is so, then does not this indicate that the lines of force encircling a wire carrying a current are probably not whirls around the wire in a plane at right angles to it, as indicated in the accompanying plan sketch, but that they are ether vortices, as shown in the sectional



ELEVATION OF ETHER VORTEX FORMED BY A PERPENDICULAR ASCENDING CURRENT.

PLAN OF LINE OF FORCE.

elevation; that whatever electricity is, its passage through the ether causes ether vortices, each cylindrical enveloping tier causing another tier of large vortices to envelop it, and so on, until the outside vortices are too feeble to generate others? And cannot all the laws of electromagnetic induction and attraction be explained by this hypothesis of ether vortices?

The Boynton Bicycle Railroad.

An exhibition was given of the Boynton Bicycle Railroad between Hagerman Station and the Great South Bay, at Bellport, L. I., on the 16th, which was witnessed by 27 members of the Massachusetts Legislature, including the members of the Senate Transit Committee, the Senate Committee on Street Railways and the House Committee on Transit. In addition to the above there were about 100 prominent railroad men from different parts of the United States, as well as a large press representation. They were entertained by Mr. Dunton, a nephew of Austin Corbin, who is president of the company, and by Mr. Boynton, the inventor. The system was fully described in The Electrical World of April 15, 1893. The road is two miles long, but in that short distance a speed of over 50 miles an hour was obtained. Mr. Boynton explained the details to those present, and Mr. Dunton delivered an address, pointing out the commercial features.

A Modified Instrument for the Determination of the $\mathfrak{B}$ $\mathfrak{H}$ Curves of Iron.

BY LEWIS T. ROBINSON.

THE writer has had in mind for some time an instrument by which the $\mathfrak{B}$ $\mathfrak{H}$ curves of iron samples could be easily and quickly obtained without troublesome calculation, the use of standard bars or a ballistic galvanometer, and which would be, when once calibrated, direct reading in C. G. S. units of both $\mathfrak{B}$ and $\mathfrak{H}$.

Prof. Ewing's "magnetic curve tracer" accomplishes this result, but is hardly suitable for workshop use. Mr. Kennelly's instrument, recently described in The Electrical World, is commercial, but is not direct reading, requires standard bars of iron and some interpolation between readings. The proposed instrument is identical in principle with the $\mathfrak{B}$ part of Prof. Ewing's device, save that the stretched wire and mirror arrangement is replaced by a D'Arsonval coil, suspended in a gap in the main circuit and carrying a constant current. Measurements are taken of the magnetic flux by its action on this coil.

Suppose we make a yoke piece of good annealed iron, provided with suitable clamps on its ends, by which the test bar can be attached, completing the magnetic circuit of the yoke, and that we surround the bar with a number of turns of wire per unit of length equal to some convenient multiple of 4π. We can then read $\mathfrak{H}$ directly from the ammeter in circuit with this coil, or at any rate the readings can be readily converted into $\mathfrak{H}$ values mentally and written down or plotted as such at once.

To observe $\mathfrak{B}$ let us cut our yoke piece, at the same time broadening the surfaces of the gap, until the permeance of the same is several times that of the sample to be tested at its highest value. We must now introduce into this gap something by which we can measure the entire number of magnetic lines passing across it, or a constant portion of them. For this purpose we will use a D'Arsonval coil, carrying a constant current and held at zero by a small torsion wire or a light spring. The coil, of course, is to be of such number of turns and carrying such a current as will allow it to become deflected over its entire scale with such a number of lines as will be developed by the samples to be tested.

Referring to the sketch, which is simply a diagram, and no attempt at a dimension drawing,

V V is the soft iron yoke;
I, sample to be tested;
T, the winding on the same;
A, ammeter in the circuit with *T*;
C, the suspended coil;
R, resistance in circuit with it;
B, the storage or other cell for furnishing the current to *C*;
G, a galvanometer;
S, a standard cell.

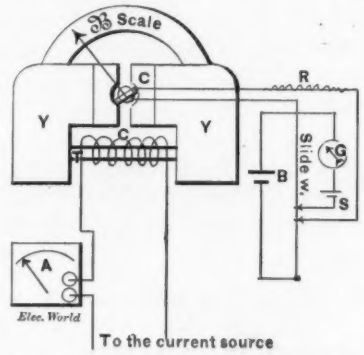
If our bars have an area of, say, 1-2 square centimetre, we can produce with the poorest iron we would be likely to test about 5,000 lines, and if in order to make our gap of great comparative permeance we are obliged to allow only 1-20 or less of these lines to be influential in moving the coil, this number will be sufficient to deflect a coil carrying a small current through its entire range.

Presuming that we can secure an arrangement of coil and field such that the angular movement of the coil is proportional to the number of lines developed in the sample, we can then number this uniform scale in such a way as to be readable as $\mathfrak{B}$ values in the sample directly. If we do not secure this result, we can easily graduate a scale to suit the instrument.

To graduate the instrument, let us assume, in the first place, that we can calculate the permeance of the gap and contacts with sufficient accuracy for our purpose, which accuracy need not be great, as the quantity in question will be very large in comparison with the permeance of the bar. We will place the bar to be tested, surrounded by a coil of, say, 79.5 turns, and over this again a secondary of a suitable number of turns to use in observing the $\mathfrak{B}$ in the bar with a ballistic galvanometer; obtaining this value, we can adjust the current in the suspended coil until we obtain a corresponding reading on the scale of the instrument. We can repeat this test at as many points of the scale as we see fit, thus calibrating it for future use.

From the instrument thus standardized we can obtain the necessary values to determine the permeability of the samples to be tested by applying a correction for the effect of the joints and the gap. We can make this correction small and of such value numerically that the results can be mentally corrected and give the values belonging to the sample alone.

In case we would prefer to determine, rather than calculate, the influence of the gap, we can proceed to graduate the instrument by means of a bar of a known quality of iron, retaining the coil for ballistic connection used before, thus testing the bar in and out of the machine, determining the influence of the gap and at the same time calibrating the scale. This would probably be the best method to use, and we would prepare a ring and bar from cast iron poured



INSTRUMENT FOR DETERMINATION OF B H CURVES.

from the same ladle, test the ring by the usual methods and be reasonably sure of having determined the quality of the bar also.

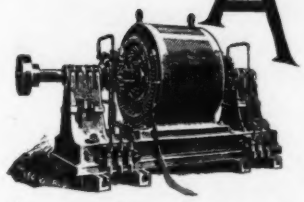
The only troublesome thing about using the instrument apparent at first sight is the maintaining of a constant current in the moving coil. A well cared for Daniels cell would probably remain constant enough in E. M. F. to be used for this purpose; or, if this is not sufficiently reliable, the arrangement shown in the diagram could be made use of; the terminals of the moving coil circuit are applied to a slide wire joining the poles of a small storage cell, to which is attached a Clark cell in the circuit of a galvanometer. By this means a voltage capable of accurate adjustment and determination can be used.

In taking tests with the instrument the resistance of the circuit containing the moving coil can be made even parts or multiples of that required to read the values marked on the scale, thus allowing us to use the instrument with a deflection easily read and as easily converted into absolute units.

The instrument is also suitable for the determination of the hysteresis of the samples, although this property of iron, which could be readily prepared in bar form, is of little importance in commercial work. In case strips of sheet iron can be attached to the clamps in such a manner as to give good contact with the yoke, satisfactory results might be obtained. The writer hopes to construct one of these instruments soon, and to find the same both convenient and satisfactory in its operation. Once standardized, it should re-

main constant as long as any sort of test instrument and give results of sufficient accuracy for all purposes in which the magnetic properties of iron are made use of commercially.

Multiphase Motors.



AN interesting article by Charles P. Steinmetz on "Multiphase Motors" is published in the "Elektrotechnische Zeitschrift," Jan. 25. As it appears to be of an eminently practical character and differs from most of the theoretical articles which have been published recently in foreign papers, we have here abstracted a number of the most important parts.

The paper deals with the history, the theory and the construction of multiphase motors, more especially of the induction type, usually called "non-synchronous." Regarding the history, he abstracts from a paper by Walter Baily, read at the Physical Society of London, June 28, 1879, on "A Mode of Producing Arago's Rotation," published in the "Phil. Mag.," October, 1879; in it are discussed the production of a rotating magnetic field by means of stationary electromagnets excited by currents of different phases; his motor was constructed of two electromagnets and a copper disc, the magnets being excited by alternating currents differing by a quarter of a period obtained from a battery by means of a commutator. Mr. Steinmetz calls attention to the multiphase generators used about twenty years ago in Paris for the Jablochkoff candles; also to the two-phase synchronous motors of Marcel Deprez; also to the Thomson-Houston arc light machine of 1879, which, he says, is probably the first practical application of the star connected three-phase winding. In referring to the Lauffen transmission plant, he claims that it was a mistake to use an induction motor, as a synchronous motor would have been better. He ridicules the idea of the fluctuations in a rotating field, about which so much has been written. Regarding the question of the priority of invention of multiphase motors, he claims that the reinventions are from five to ten years later than the work of Baily, Deprez and Ferraris.

Among the recent improvements he mentions a better arrangement of the magnetic circuit, the diminishing of the self-induction, the constant self-induction coefficient for all positions of the armature; regarding the many frequently advanced mathematical theories, he says no two of them agree together nor with the results of practice, which he explains by the fact that the authors are such as have never constructed a motor and perhaps have never even seen one; they conclude that the self-induction of the armature should be as high as possible, while practical experience shows that the chief factor in the construction is to make it as small as possible; another claims that the theory of hysteresis is at the foundation of the action of the motors, while practice shows that the lower the hysteresis the better the motor; regarding the starting torque, diminution of speed, phase differences, etc., he says there exists the worst kind of confusion; it is therefore easily understood that the present state of the multiphase induction motor industry, as shown at the World's Fair and in journals, is very discouraging; if these motors cannot start with full load with a normal current there is no use for them, for without a load the simple alternating-current motor will start, the efficiency, output, etc., being the same. All the multiphase induction motors at the World's Fair, except one, had the same faults, namely, small starting torque, great current at starting, some being even incapable of starting loaded; high self-induction, great phase difference and great diminution in speed, all of which he calls faults, as he claims that they can be overcome.

He gives briefly a few conclusions which were substantiated by properly constructed motors; such motors can be calculated more completely and with greater accuracy than even continuous-current motors; the same torque per watt can be obtained at starting, and even more, as at full speed and full load; the motor can therefore start with full load without requiring more current than at full speed. With a special construction the starting torque may be made two or three times as great per watt as at full speed; they can stand considerable overloading, the amount depending on the purpose for which the motor is to be used; in some cases it may stand several hundred per cent. overloading; the reduction in speed between no load and full load can be made as low or as high as one wishes, without its materially affecting other properties of the motor; in general, however, the drop in speed at full load is less than in an ordinary shunt motor of equal size; the efficiency should be at least equal to that of a continuous-current motor; the current for no load, or the exciting current, should not exceed 20 to 30 per cent. of that at full load; the shifting of the phase of the current behind that of the E. M. F. should be small and the ratio of the true to the apparent watts should therefore be great; in large motors between one-quarter load and 50 per cent. overload it is equal to 0.9, and even in small motors should not below 0.8; this phase shifting is due to three factors, the self-induction of the armature, that of the primary circuit, and the exciting current; the latter diminishes while the other two increase, so that with an increasing load the phase shifting diminishes from a maximum at no load, reaches a minimum and then increases. Regarding the frequency, he states that they can be built equally well and with the same efficiency for 130 periods as for 30, provided the magnetic disposition is the same, to arrive at which the peripheral velocity must be greater for higher frequencies; motors can be built for 130 periods, which will start at full load and normal current and differ only from motors with lower frequency by an increased current at no load and a somewhat greater phase shifting. Single-phase induction motors have only 50 to 60 per cent. of the starting torque per watt, and unless multiphase motors are better in this respect, there is no advantage in their introduction. It is a mistake to use induction motors wherever alternating-current motors are required; as synchronous motors are so much better, they should be used in preference whenever possible; they have a higher efficiency, are smaller and may have a negative phase shifting at no load, the current being proportional to the load.

Edison Wire Gauge.

Prof. Hospitalier, in the new edition of the "Formulaire des Electriciens," gives the following formulas for finding the equivalent of the Edison wire gauge in millimetres, or French wire measure:

$$s = .5067\ n\ \text{mm}^2$$
$$d = .8031\ \sqrt{n}\ \text{mm},$$

where s is the section, d the diameter and n the circular mils.

News to Hawaii by Telegraph.

Our contemporary, London "Electricity," contains an article on Pacific cables, in which it sums up the length of the routes by which President Cleveland's decision reached the Sandwich Islands via New Zealand: it gives all the various cables and land lines forming the circuit, the total length of which was 19,123 miles from New York to New Zealand.

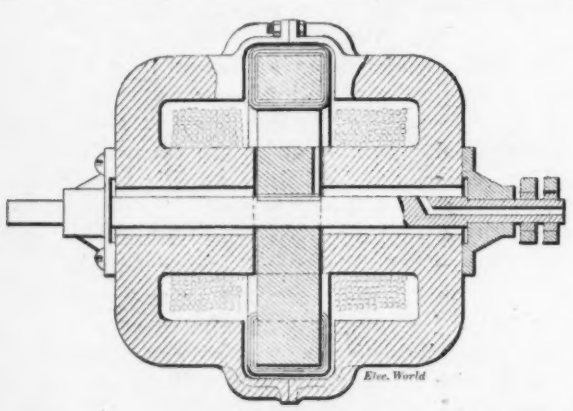
Unipolar Dynamos of the "Inoperative" Type.

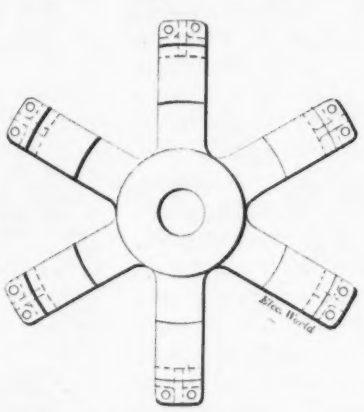
BY BRUCE FORD.

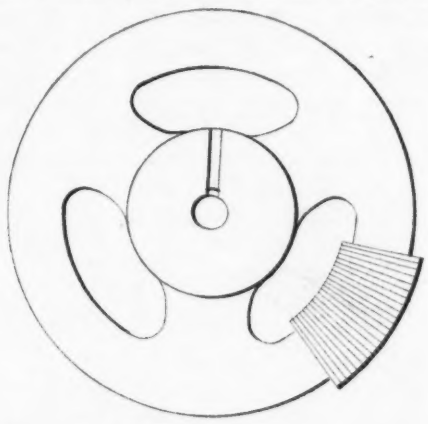
THE interest in this subject demonstrated by recent articles appearing in The Electrical World prompts me to put my finger in this pie and advance a theory upon the subject of the rotating magnet with stationary exciting coil, under discussion by Messrs. Carl Hering and A. Randolph in the issue of Feb. 3.

First, it may be well to describe, by the aid of the accompanying figures, a machine built as an experiment by me a year ago, and from which my conclusions are deduced.

As may be readily seen in Fig. 1, the machine consists essentially of three parts, two main spider-like castings, as Fig. 2, constituting the stationary part of the field, and one revolving piece, Fig. 3, which I shall call the armature, although it is only a part of the field, of opposite polarity to the spiders. Each of the spiders has six poles and is excited by a single coil, like the magnet of the Mordey alternator; the two parts combined, however, have this difference: The extremities are of the same polarity, and so are bolted together at the poles. The armature, Fig. 2, is a wheel-like casting, consisting of an iron rim connected to a hub by three spokes of large cross-section, the latter serving to complete the magnetic circuit between the rim and the hub. Only the rim is wound, a single wire being wound in a continuous coil all the way around the armature. Part of the winding is shown in place. The terminals pass down a groove in the side of the armature hub into a hole in the shaft and out beyond the bearing to the collector rings.







FIGS. 1, 2 AND 3.—UNIPOLAR DYNAMOS OF THE "INOPERATIVE" TYPE.

In the assembled machine the magnetic lines excited by the coils on the hubs of the spiders pass out through the six limbs of the spiders to the pole pieces, jumping across the gap into the armature rim. The armature windings cut these entering lines of force here, and in one direction. The magnetic circuit is completed through the spokes of the armature. The fact that these spokes revolved led me to believe that the magnetic lines in them would also revolve and that the wire would not cut any lines of force leaving the rim of the armature. My mistake lay in the assumption that part of the magnetic circuit could revolve while the remaining part was stationary.

In testing the machine the fields were excited from storage batteries, and showed strong excitation. The armature shaft was coupled directly to the shaft of a motor, and the terminals were connected to a Weston direct-current voltmeter. The current was then turned on to the motor, and the speed came up to about 1,000 revolutions per minute. The voltmeter showed absolutely no deflection, although, had the machine been successful, it should have shown nearly 100 volts. I next disconnected all the armature windings, except a small coil of a few turns. Upon starting the machine the wagging of the voltmeter needle at both sides of zero showed an alternating current. The meter of course failed to show this as the speed increased, and, alternating meters not being at hand, the machine was not tested as an alternator. The alternating effect was due doubtless to different densities of the field at different points during the revolution.

I also tried to make this machine run as a motor, but with no success. Could the lines of force have been twisted upon themselves infinitely, so that only the entering lines of force would have been cut, the experiment would have been successful.

Mr. Hering, in his article, Jan. 13, states that the lines of force are said to follow the coil which generates them. Mr. Randolph differs in his belief and cites some examples, one of which is a proposed stationary exciting coil on the rotating field magnet of the Mordey alternator.

Where part of the core rotates and part remains stationary, Mr. Randolph states that the lines of force might follow either part.

In the last case it is my belief that the lines of force remain wholly with neither part of the core. For instance: Imagine two mushroom-shaped magnets of equal size, each excited in opposite polarity by a coil wound upon the part corresponding to the stem of the mushroom. Place the two magnets together in line "stem" to "stem"; between the two we have one complete magnetic circuit. Now rotate one of the "mushrooms" and its coil about its axis. Is the magnetic circuit broken? Scarcely. Is the magnetic circuit twisted upon itself infinitely? According to Mr. Hering and to my own machine, it cannot be. Naturally, then, the lines of force cannot remain with both cores or with both coils, and my conclusion is that in this case the magnetic circuit, tending to remain with both parts, revolves at one-half the velocity of the rotating magnet.

If, as in this example, where the magnetic circuit has two coils, the lines of force do not always follow the coil that generates them, may it not also be true that when only one coil is used the lines of force tend to move (though perhaps not coincidently) with the core when the core revolves and the coil remains stationary?

(In replying to this communication, I merely wish to add that I constructed a precisely similar but smaller machine in 1884, and it was on the results obtained that I based some of the remarks made in the article referred to by Mr. Ford. His experiments, therefore, confirm mine.—Carl Hering.)

Sweeping Up Molecules of Gas With a Broom.

Dr. Lodge recently stated in a contemporary that at the temperature of absolute zero the molecules of a perfect gas "would be lying all about the floor in an inert and stationary condition and could be swept up."

A Straight Line Proportion in the Law of the Electromagnet.

BY CARL HERING.

DR. O. FROELICH, whose formula for the electromagnet, published many years ago, is so well known, recently read an interesting paper on the electromagnet before the Electrical Society of Germany, which is reprinted in full in the "Elektrotechnische Zeitschrift," Jan. 18, page 39. In it he deduces "a straight line proportion," which enables the law to be stated in the form of a formula, which apparently gives sufficiently accurate results for all practical purposes. The object of the present article is to give a brief abstract of the rather lengthy paper for the benefit of those to whom the original is not accessible. We will also endeavor to "Americanize" the formulas by reducing them to a practical form by using the symbols and names which are to be introduced in this country. Some of his statements are not as clear as might be desired, but we believe from deductions and comparisons made with his formulas, that we have interpreted him correctly. Furthermore, some of his fundamental formulas contain what appear to be typographical errors besides an arbitrary factor of 1,000; we have corrected the formulas and omitted the latter factor, as it is, we think, confusing, its only use being to increase the numerical values of certain constants. We have also changed the symbols to those recommended by the recent congress, except in the case of K, which, in this abstract, refers to constants.

In the first part he reconciles the two present theories of electromagnetism with each other; this, although interesting, we will here pass over. In the second part he deduces his new law. As is well known, the analogy between the law of the electric circuit and that of the magnetic circuit does not apply in the case of resistance and reluctance, as the reluctance is not a constant, but varies with the M. M. F.; that is, with the gilberts. As an independent variable, only the flux (webers) or flux density (gausses) can be used, similarly as in the electric circuit, in which the electric properties of a body, like the resistance and polarization of an electrolytic bath, can depend only on the current and not on the E. M. F. of the battery used. Among the dependent variables are the magnetic fall of potential (magnetische Gefaelle) and the reluctance (oersteds).

He then proceeds to deduce his law, as a basis of which he uses the linear proportion first pointed out by Mr. Kennelly in his able paper read before the American Institute of Electrical Engineers on Oct. 27, 1891 (see the Transactions, or a reprint which was published in The Electrical World Nov. 7, 1891, page 350). Mr. Kennelly showed that with the exception of the unimportant first part of the curve, the magnetic reluctance is the linear function of the M. M. F. or ampere turns when the circuit consists only of that iron. Dr. Froelich here introduces a new quantity, which he calls "Saettigungsverhaeltniss," which might be translated literally as the saturation relation; this he defines as the relation between the existing number of lines, to the difference between the maximum number of lines and the existing number of lines. Or, to put it in the form of a formula, letting Z represent this saturation relation, then

$$Z = \frac{\Phi}{\Phi_m - \Phi}$$

in which Φ represents the existing flux (in webers or lines of force) and Φ_m the maximum flux. This quantity differs from what is usually called the saturation, as the latter is the relation of the existing flux to the maximum flux, that is, $\frac{\Phi}{\Phi_m}$. The saturation relation has the property in common with M. M. F. and reluctance, that it may increase to infinity. The saturation relation is unity when the saturation is one-half, and it is infinity when the saturation is one.

By plotting the values of this saturation relation as abscissae and the reluctances as ordinates, both for wrought and cast iron, he obtains the curves shown in Fig. 1, which

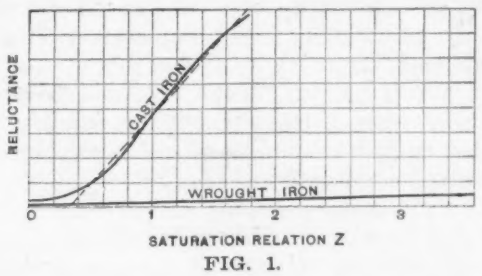


FIG. 1.

he states can be replaced by straight lines, the error for the range used in practice being no greater than what is allowable. Representing the saturation relation by Z, he states that for wrought iron the straight-line proportion may be assumed to begin at $Z = 0.2$, corresponding to a saturation of 0.17, while for cast iron it begins at $Z = 0.5$, corresponding to a saturation of 0.33. He therefore assumes that the reluctance of iron is a linear function of the saturation relation, and on the basis of this he deduces his law. The fundamental formula thus becomes

$$\nu = k + k' Z = k + k' \frac{\mathfrak{B}}{\mathfrak{B}_m - \mathfrak{B}}$$

in which ν is the specific reluctance or reluctivity (reluctance per unit length and cross-section), k and k' are constants and Z the saturation relation, which in this formula may be represented in terms of the flux per square centimetre; that is, by $\frac{\Phi}{S}$, S being the cross-section, which is usually termed the induction and is represented by $\mathfrak{B}$. This formula does not apply to low saturation when the circuit consists entirely of iron, but when it contains air also, the reluctance of which is much greater than that of the iron, it may be used even for low saturation. From the researches of Hopkinson he deduces the constants for wrought and cast iron, and obtains the following: For wrought iron $k = .000250$, $k' = .000250$, $\mathfrak{B}_m = 17{,}700$ (gausses); for cast iron $k = .00375$, $k' = .0112$, $\mathfrak{B}_m = 14{,}700$.

He then assumes an electromagnet of equal cross-sections throughout, and without leakage or spreading of the lines of force; the only form of magnet of this kind which we can conceive is a ring magnet with a short air space. For this the formula for the total reluctance will then be

$$\mathfrak{R} = \frac{4\pi}{10} \frac{A\,T}{\Phi} = \frac{l}{S} + \frac{L}{S} k + \frac{L}{S} k' \frac{\Phi}{\Phi_m - \Phi}$$

in which $\mathfrak{R}$ is the reluctance (in oersteds), $A\,T$ the ampere turns, Φ and Φ_m the total and maximum flux (in webers) respectively, L and l the lengths of the iron and the air circuits respectively, in centimetres, S the cross-section in square centimetres, k and k' the above constants. By letting

$$\frac{l}{S} + \frac{L}{S} k = K$$

and

$$\frac{L}{S} k' = K'$$

this becomes

$$\mathfrak{R} = \frac{4\pi}{10} \frac{A\,T}{\Phi} = K + K' \frac{\Phi}{\Phi_m - \Phi}$$

which he calls his practical law of the electromagnet.

The constants have what he terms a natural meaning; K being the starting or dead reluctance of the magnet and K' the coefficient of increase (Wachsthums koefficient); the former depends almost entirely on the air space and the latter, as also Φ_m, depend only on the iron. The values of the constants K and K' are given for several machines, but as neither the dimensions nor even the output of the machines are stated, it would be of little use to give it here.

He then deduces a general formula for the magnetic circuit of a dynamo, taking into consideration all the various dimensions and magnetic qualities of the air space, the iron in the armature, magnets, cores, pole and yoke pieces, as also the coefficients of leakage; but this formula appears to us to be too cumbersome to be of use in practice, and it will therefore not be given here. A simpler approximate formula is also given, agreeing with the other in three points of the curve, but this also is hardly sufficiently simple for general practical applications. He also shows how the formula may be determined from the characteristic of a finished dynamo.

While we fully appreciate the value of some general practical formula for calculating field magnets, yet if it does not simplify the calculations as usually made, such a formula is merely interesting, but not very useful. We might suggest here that the first formula for calculating the specific reluctance, or possibly another deduced from it expressing the total reluctance, might be of real practical value, provided the constants for the various qualities of iron are known and can be depended upon, by which we refer more particularly to the maximum magnetism, which is not a very definite quantity. This would enable one to calculate the reluctances of the various different parts of the heterogeneous magnetic circuit of a dynamo for any desired flux, and the leakage coefficients can then readily be introduced; after having determined these reluctances the rest of the calculation to determine the ampere turns would be a very simple matter. Such a formula would have the advantage over the one usually used merely in that the calculations are algebraic, using numerical constants, instead of graphic, with the use of curves, but whether there are any real advantages gained is a question.

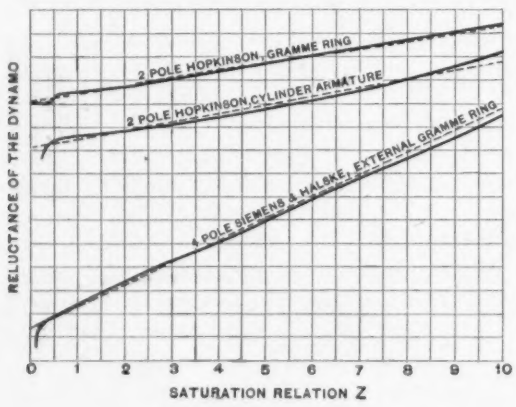

2 POLE HOPKINSON, GRAMME RING
2 POLE HOPKINSON, CYLINDER ARMATURE
4 POLE SIEMENS & HALSKE, EXTERNAL GRAMME RING
RELUCTANCE OF THE DYNAMO
0 1 2 3 4 5 6 7 8 9 10
SATURATION RELATION Z

FIG. 2.

To show the correctness of his formula for the magnetic circuit of dynamos, he gives the calculated and observed results for three totally different machines, which are shown in Fig. 2 by dotted and full lines respectively; the results appear to be very satisfactory. It is of interest to note that by thus representing the characteristic of a dynamo, or more correctly speaking, of the magnetic field, it becomes a straight line.

Regarding the practical application of this law to the calculation of the field magnets of a dynamo, he admits that it offers no advantages over the methods now in use, as it is only another form of the Hopkinson method; the former is an algebraic method and the latter a graphical one. The advantages of his method appear in the application of this law to the observations of a finished machine, as by means of it various factors, such as the air reluctance, the various constants, including those of the iron, the saturation, etc., are brought out separately, while in the graphical method they are all combined together. His law thus enables one to study a machine more thoroughly, as it reduces a heterogeneous magnet to an equivalent in the form of a simple magnet of uniform cross-section, and thereby affords a means of comparing machines of totally different types. The law is also claimed to be of use for studying the magnetic qualities of different samples of iron. In concluding, he shows how the law may be applied to the final calculations of the length of the core of the field magnet and the ampere turns encircling this core, after all the other dimensions have been decided upon. He also refers to a mathematical discussion of his magnetic deductions in a former paper published in that journal, June 30, 1893, page 365.

In concluding, we might add that while his new method is of interest and may be of use in special cases, it does not appear to be a sufficient advance to replace the methods at present in use. A general formula has some advantages, but so has also the less scientific but more practical method of making a few trial calculations.

Mr. Preece's Views of America.

In a recent address in London Mr. Preece made the following remarks regarding the Chicago Congress: "Perhaps the most useful result of the congress was the bringing together of such an international mixture of electricians, making friendships, allaying jealousies, and breaking down national prejudices. Electricity is the only branch of science which has but one language, and it is now quite cosmical in its character. Congresses do infinite good in promoting friendliness among nations." Regarding the World's Fair, he said: "Nothing grander in design or more beautiful in execution has ever been seen in this world than the group of buildings situated in Jackson Park, Chicago, and called the 'World's Fair.'" * * * "Every possible convenience and accommodation was provided for exhibitors, but the response was poor, and the internal management of the whole business, owing to inexperience and perhaps overweening confidence, was indifferent." * * * "The American public were surprised to find how much we had anticipated their work." * * * "The distinguishing feature of American engineering is the great scale on which it is carried out, and the rapidity of its adoption."

Patrick and the Telephone.

Our contemporary, London "Electricity," reprints a little anecdote by Mr. Stuart-Smith from his recent article in The Electrical World, intimating that it is a "chestnut," but adds another, which, though much older, may still be worth reprinting. When the telegraph was first introduced into Ireland, Patrick had a brother residing some distance away who was hard up and asked him to supply him with a pair of boots. The boots were secured, and Patrick hung them up on the telegraph wire, addressed to his fraternal relative. The next morning he went to see if they had gone. They had, and in place thereof he found a pair of soleless shoes. He said: "This is a wonderful invention. Dennis has not only got his new boots, but has sent me back his old shoes."

Storage Battery Cars.

During the recent snows the Waddell-Entz storage battery cars on Second avenue received high praise for the admirable manner in which they performed their work. While the horse cars required four horses and ran on double time, the electric cars did not have the least difficulty on their trips.

Formulæ for Resistance Coils.

BY GUSTAV RENNERFELT.

THE formulae given below may be found useful for determining the dimensions of a bare conductor of a certain resistance, carrying a certain current, and having a certain proportion between the watts expended in the conductor and its surface.

The formulae are derived in the following manner:

Let R = Resistance in ohms.
C = Current in amperes.
f = Number of square units surface for each watt consumed in the conductor.
S = Surface of conductor (leaving out end surfaces).
x = Area of cross-section of conductor.
y = Length of conductor.
W = Weight of conductor.
k = Specific resistance of material in conductor.
s = Specific gravity of material in conductor.

Before any of the dimensions can be determined it is necessary to know the shape of the cross-section, whether it is a circle, a rectangle or some other figure. For any figure we have the relation $p = m\sqrt{x}$, where p denotes perimeter of the figure, x the area, and m is a quantity depending on the shape of the figure. For instance, for a square $m = 4$, and for a circle $m = 2\sqrt{\pi}$, which, by the way, is smaller than for any other figure.

Knowing the shape of the cross-section, and consequently the value of m, we can write the equations:

$$S = p\,y = y\,m\sqrt{x} \text{ and}$$
$$S = f\,C^2\,R$$

from which we have

$$y\,m\sqrt{x} = f\,C^2\,R \qquad (1)$$

We also know the resistance of the conductor to be

$$R = \frac{y}{x}\,k \qquad (2)$$

Equations (1) and (2) give us:

$$m\,x\sqrt{x} = f\,C^2\,k, \text{ or } x = \sqrt[3]{\frac{f^2\,C^4\,k^2}{m^2}}$$

We have thus the area of the cross-section:

$$x = \sqrt[3]{\frac{f^2\,k^2}{m^2}}\,C\sqrt[3]{C} \qquad (3)$$

In order to find the length y, we can put in equation (1) $x = \frac{k\,y}{R}$, which gives $y\,m\sqrt{\frac{k\,y}{R}} = f\,C^2\,R$, or

$$\text{length of conductor } y = \sqrt[3]{\frac{f^2}{k\,m^2}}\,C\,R\sqrt[3]{C} \qquad (4)$$

The weight of the conductor is

$$W = s\,x\,y = s\sqrt[3]{\frac{f^4\,k}{m^4}}\,C^2\,R\sqrt[3]{C^2} \qquad (5)$$

To make the formulae (3), (4) and (5) more convenient to use, some of the cube roots may be arranged in a table, and the formulae rewritten thus:

$$x = \alpha\,\beta\,\gamma^2\,C\sqrt[3]{C} \qquad (6)$$

$$y = \frac{\alpha\,\beta}{\gamma}\,C\,R\sqrt[3]{C} \qquad (7)$$

$$W = s\,\alpha^2\,\beta^2\,\gamma\,C^2\,R\sqrt[3]{C^2} \qquad (8)$$

where the values of the constants are

$$\alpha = \sqrt[3]{f^2},\ \beta = \sqrt[3]{\frac{1}{m^2}},\ \gamma = \sqrt[3]{k}.$$

γ is thus depending on the material, β depends on the shape of the cross-section, and α on the ratio between surface and watts. Their values for some varying conditions are given in the following three tables:

Table No. 1 is figured for the English inch as unit, and with the assumption that the specific resistance varies according to the formula: $k = k'(1 + a\,t + b\,t^2)$, where is a temperature in degrees C., k resistance at temperature t, and k' resistance at temperature 0° C. The constants k', a and b are assumed as follows.

	k'	a	b
German silver	.0000090	.00044	.000000152
Iron	.0000040	.0048	.00000126
Aluminium	.0000013	.0038	.00000126
Copper	.00000066	.0038	.00000126

The figures in column s of table No. 1 mean weight in pounds per cubic inch of the material.

Table No. 2 gives values of α and α^2 for values of f varying from $^1/_2$ to $2^1/_2$ square units per watt.

TABLE NO. I.

	−60° C. = 140° F.−			−100° C. = 212° F.−			−150° C. = 302° F.−			
	γ	$\frac{1}{\gamma}$	γ^2	γ	$\frac{1}{\gamma}$	γ^2	γ	$\frac{1}{\gamma}$	γ^2	s
German silver	.0210	47.66	.000440	.0211	47.37	.000446	.0213	47.02	.000452	.306
Iron	.0173	57.83	.000299	.0181	55.12	.000329	.0191	52.29	.000366	.278
Aluminium	.0117	85.50	.000137	.0122	82.06	.000149	.0128	78.34	.000163	.093
Copper	.00936	106.8	.0000876	.00976	102.5	.0000953	.0102	97.77	.000105	.320

TABLE NO. II.

sq. ins. per watt	.50	.67	.75	1.00	1.33	1.50	1.66	2.00	2.50
watts per sq. inch	2.00	1.50	1.33	1.00	.75	.67	.60	.50	.40
α	.630	.763	.826	1.00	1.211	1.310	1.402	1.587	1.842
α^2	.397	.582	.681	1.00	1.468	1.717	1.966	2.520	3.393

TABLE NO. III.

			Rectangular sections.									
	Circle.	Square.	2:1	3:1	4:1	5:1	6:1	7:1	8:1	9:1	10:1	11:1	12:1
β	.430	.397	.382	.361	.342	.326	.313	.301	.291	.282	.274	.267	.261
β^2	.185	.158	.146	.130	.117	.106	.098	.0908	.0848	.0797	.0753	.0714	.0681

Table No. 3 gives values of β and β^2 for some different cross-sections, circular, square and rectangular, with different proportion between the sides.

It is evident that the formulae in question are equally applicable if there are several conductors of the same size arranged in parallel, instead of a single conductor. The value of m will, however, in such a case be different, and consequently the value of β. It is easily seen that if the number of conductors in parallel is n, the value of m is $\sqrt{n}$ times as great as the value of m for a single conductor—cross-sections being similar.

If there are n conductors in parallel, the value of β as given in table No. 3 must therefore be multiplied by $\sqrt[3]{\frac{1}{n}}$ and β^2 $\sqrt[3]{\frac{1}{n^2}}$.

As the cross-section is proportional to β and the weight to β^2, it is thus seen that, for instance, the using of two conductors in parallel instead of one will for the same

heat density or ratio of watts to surface admit of the cross-section being reduced to $\sqrt[3]{\frac{1}{2}} = .79$, and the weight to $\sqrt[3]{\frac{1}{4}} = .63$.

Using three conductors in parallel instead of a single one will for the same heat density reduce the cross-section to 69 per cent. and the weight to 48 per cent.

As a comparison between the four mentioned metals may be drawn the following conclusions:

A coil with fixed conditions in regard to resistance, strength of current, heat density and shape of cross-section
has the least weight if made of.....Aluminium
has the least bulk if made of.....Copper
has the least price if made of.....Iron
has the least variation in resistance if made of..German silver

An example will show how the formulae can be used. Suppose a coil of bare, round, pure copper is required to carry 350 amperes and to offer a resistance of .000943 ohm at 100° C. If the working conditions are such that 100° temperature will be reached, if there are .60 watts per square inch surface, what dimensions should be given to the coil?

From the tables are found the constants:

$\alpha = 1.402$, $\alpha^2 = 1.966$, $\beta = .430$, $\beta^2 = .185$, $\gamma = .00976$,

$$\gamma^2 = .0000953, \quad \frac{1}{\gamma} = 102.5, \quad s = .32.$$

We thus have cross-section $x = 1.402 \times .430 \times .0000953 \times 350 \sqrt[3]{350} = .142$ square inches, length $y = 1.402 \times .430 \times 102.5 \times 350 \times .000943 \sqrt[3]{350} = 143.7$ inches.

A wire 12 feet long and with $^7/_{16}$ inch diameter would thus be suitable. The weight of the wire is 6.53 pounds.

If other metals than copper were used, but we still kept a circular cross-section and .60 watts per square inch surface, the weights would be:

For iron, $\frac{181 \times 278}{97.6 \times 320} \times 6.53 = 10.5$ pounds.

For German silver, $\frac{211 \times 306}{97.6 \times 320} \times 6.53 = 13.5$ pounds.

For aluminium, $\frac{122 \times 93}{97.6 \times 320} \times 6.53 = 2.37$ pounds.

The aluminium coil would thus be by far the lightest one, but would, however, require 25 per cent. more room than the copper coil. By using any other cross-section than the circle, the weight and dimensions can, of course, be reduced. If, for instance, rectangular section were used, with ratio 7:1 between sides, the weight would go down to $\frac{90.8}{185}$, or about one half.

The Chicagonian Outdone.

In speaking of the large German search light on the Manufactures Building at the World's Fair, a native of Chicago stated as something wonderful that he had seen it when he was in Milwaukee, to which the attendant replied: "Dots notting; I seen him venn I vos in Nuremberg, in Charmenny."

Technical Review of the World's Fair.

Two French engineers, Messrs. Grille and Falconnet, are about to publish a technical review of the World's Fair, which is to form ten to twelve volumes in 8vo and several additional volumes, comprising 400 plates, in quarto. It will be published by Bernard et Cie., of Paris, and is to be completed at the end of this year at the latest.

On the Design of Electromagnets for Specific Duty.

BY CARY T. HUTCHINSON.

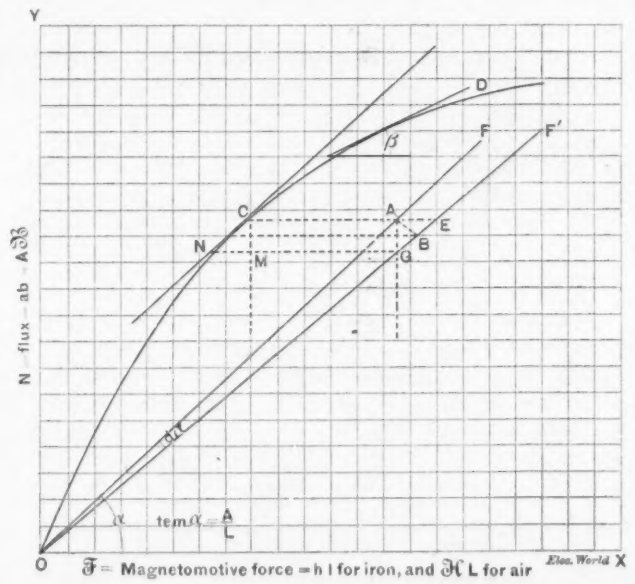
AN article by Mr. E. R. Carichoff on this subject was published in The Electrical World of Jan. 27. The results brought out by the writer are valuable, and, I believe, new. The article is perfectly clear, when properly understood, and deserves the commendation it received in the editorial columns of the paper.

Mr. P. Mathews, however, publishes an article in the last number of The Electrical World which plainly shows that he does not entirely understand the article, and it seems worth while to present Mr. Carichoff's results in a slightly altered form, that may be more easily understood.

His problem is: Having given a magnet of definite length and cross-section, an air gap of given length, and any constant magnetomotive force, to find the polar area giving the maximum force.

Let A, L, $\mathfrak{B}$, $\mathfrak{H}$ and $\mathfrak{F}$ represent respectively the area, length, induction, magnetic force and magnetomotive force of the air gap; a, l, b, h and f, the same quantities for the iron; N, the flux, which is the same in iron and air, since no leakage is assumed.

The curve $O\,C\,D$ is the characteristic of the iron; that is to say, the ordinates are flux, $N = a\,b$, and the abscissæ are magnetomotive force, $f = h\,l$; the air line $O\,F$ is the same, ordinates being $N = A\,\mathfrak{B} = A\,\mathfrak{H}$, and abscissae, $\mathfrak{H}\,L$;



DESIGN OF ELECTROMAGNETS FOR SPECIFIC DUTY.

therefore the tangent of the angle $F\,O\,X = \frac{A}{L}$ represents the permanence of the gap. The tangent of the angle (β) that a tangent to curve $O\,C\,D$ makes with $O\,X$ is represented by

$$\frac{dN}{df} = \frac{a\,db}{l\,dh} = \tan\,\beta.$$

The curve $E\,C\,D$ in Mr. Carichoff's paper is the same curve, reduced to unit length and unit area of iron; the equivalent gap length then being $L' = \frac{L}{l}$.

The ordinates of his curve are then $\frac{N}{a} = b$, and the abscissæ, $\frac{f}{l} = h$; that is, the ordinary $\mathfrak{B}$ $\mathfrak{H}$ curve for the iron; the ordinates of the line $O\,F$ are $\frac{N}{a} = \frac{A\,\mathfrak{H}}{a}$, and the

abscissæ $\mathfrak{H} \frac{L}{l}$. Then tangent $\alpha = \frac{A\ l}{a\ L}$ and tan $\beta = \frac{db}{dh}$.

In what follows I shall refer to the figure above, but it will readily be seen that everything said here applies to Mr. Carichoff's curves.

Then assuming the area A is the only variable, for maximum force I find

$$\text{Force} = P \sim A\ \mathfrak{B}^2 = A\ \mathfrak{H}^2 \qquad (1)$$

$$\frac{dP}{dA} = 2\ A\ \mathfrak{H}\ \frac{d\mathfrak{H}}{dA} + \mathfrak{H}^2 = 0 \text{ for maximum}$$

$$0 = 2\ A\ \frac{d\mathfrak{H}}{dA} + \mathfrak{H} \qquad (2)$$

$$\text{Total M. M. F.} = \text{constant} = \mathfrak{H}\ L + h\ l \qquad (3)$$

$$0 = L\ \frac{d\mathfrak{H}}{dA} + l\ \frac{dh}{da}$$

$$\frac{dh}{dA} = -\frac{L}{l}\ \frac{d\mathfrak{H}}{dA} \qquad (4)$$

$$\frac{db}{dA} = \frac{db}{dh}\ \frac{dh}{dA} = -\frac{L}{l}\ \frac{db}{dh}\ \frac{d\mathfrak{H}}{dA} \text{ from (3)} \qquad (5)$$

$$N = A\ \mathfrak{H} = a\ b \qquad (6)$$

$$A\ \frac{d\mathfrak{H}}{dA} + \mathfrak{H} = a\ \frac{db}{dA} \qquad (7)$$

therefore

$$A\ \frac{d\mathfrak{H}}{dA} + a\ \frac{db}{dA} = 0, \text{ (7) in (2)} \qquad (8)$$

and

$$A - L\ \frac{a\ db}{l\ dh} = 0, \text{ (5) in (8).} \qquad (9)$$

or

$$\frac{a\ db}{l\ dh} = \frac{A}{L}$$

$$\frac{dN}{df} = \frac{A}{L}. \qquad (10)$$

that is,

$$\tan \beta = \tan \alpha \qquad (10)'$$

That is, for maximum force, the line $O\ F$ is parallel to the tangent. It is obvious that if work be defined as "force and length of gap" the same condition holds for maximum work, the area being the variable.

When the magnetizing force is small and may be taken constant, then (10) means

Reluctance of iron = Reluctance of air gap.

Mr. Mathews has clearly misunderstood Mr. Carichoff's figures; the statement at the end of his article that the reluctances are in inverse ratio of the sections is not a consequence deducible from Mr. Carichoff's article; moreover, it is wrong.

Mr. Mathews works out correctly the other problem of the best length for the gap, with constant area, to give maximum work, work being defined as above. The result is, as one would expect, that the reluctances (for constant μ) of the two parts should be equal. He works it out only in the case of constant permeability. For the general case the deduction is as follows:

The equations are—

$$N = A\ \mathfrak{H}^2\ L \qquad (11)$$

$$\frac{dN}{dL} = 0 = 2\ A\ L\ \mathfrak{H}\ \frac{d\mathfrak{H}}{dL} + A\ \mathfrak{H}^2 \qquad (12)$$

$$F + f = \mathfrak{H}\ L + h\ l \qquad (13)$$

$$\frac{dh}{dL} = \frac{dh}{db} \cdot \frac{dh}{dL} \qquad (14)$$

Differentiate (13); substitute from this and from (14) in (12) the result is

$$\frac{a\ db}{l\ dh} = \frac{A}{L} \qquad (15)$$

and for constant μ this is,

Reluctance of iron = Reluctance of air gap,

as Mr. Mathews finds.

There is, of course, no condition for maximum force when the gap length is the variable.

These results are similar to the conditions for maximum work of a battery, and, like them, are independent of the magnetomotive force; they apply to all values of the magnetomotive force. This is the meaning of the locus curve in Mr. Carichoff's article.

Cost of Operating a Municipal Plant.

The city authorities of Topeka, Kan., have issued a financial account of the municipal electric street lighting plant from its institution in November, 1889, to December, 1892, from which we abstract the following:

The plant consists of a lot and building by a railroad switch. There are three boilers and three engines (worked to 235 h. p.); six Jenney (Indianapolis) arc dynamos of 30-lamp capacity each; six circuits, with 24 72-100 miles of pole line and 33 5-10 miles of wire, supported on 943 30-foot poles. The lamps are suspended between 40-foot poles at the centre of each intersection on the principal streets, and at each alternate intersection on the residence streets. The greater portion of the lamps are 1,100 feet apart one way and 800 feet the other, making in all 184 lamps, rated at 2,000 c. p. A test of seventeen lamps showed an average voltage of 23 15-100 and a current of 19 amperes, or 439 85-100 watts, equivalent to 1,953 nominal candle power. The cost of the lot and building was $8,559.33; of the plant, poles and wires, $46,888.65, making a total cost of $55,447.98.

The average cost of each arc light during the time that the plant has been in operation has been $93 per year, or $7.75 per month, or $3.86 per 100 hours, divided as follows:

	Per centum.
Fuel (at $2.75 per ton)	25.67
Carbons	5.51
Globes	.43
Oil and waste	1.18
Repairs	8.93
Insurance and telephone	2.45
Superintendence and labor	36.40
Interest at 6 per cent	19.43
	100.00

The Azores Cable.

The following letter, written by a cable man in the Azores and published in the London "Electrician," is rather amusing: "The people at Pico said that the cable was the cause of the cyclone, but as it saved them from starving, by bringing the milho at once, they don't consider it such witchcraft as they did at first. It is a fact, though, that the fishermen have said that the 'talking' in the cables has frightened the fish away! People in Pico would not have the land line insulators on their houses because of this same 'talking.' I have been told that if I had been here a quarter of a century earlier I should have stood a chance of being burnt, and should have figured in the annals of electricity as a martyr to the science."

Effects of Temperature on the Breaking Strain of Metals.

Prof. Dewar, in his recent lecture on "The Scientific Uses of Liquid Air," showed that the breaking strain of metals at 180° C. below zero was greatly increased; in the case of iron and German silver it was nearly doubled; in certain metals an equally remarkable increase occurs in the percentage of elongation before rupture.

Rope Driving.—IX.

BY J. J. FLATHER.

THE ropes most commonly found in use are from 5-8 inch to 1 3-4 inches in diameter, although other sizes are frequently employed; in one case, cited by Mr. T. S. Miller,* a rope no larger than 5-16 inch diameter is used very satisfactorily to transmit 20 h. p.

The largest rope in use for this purpose, as far as the writer is aware, is 3 1-2 inches in diameter; it is of cotton (Lambeth), and is used to drive the cable drums in the Washington street power station of the North Chicago Street Railway Company.

In England and Germany ropes smaller than 1 inch in diameter are seldom employed; in ordinary cases the sizes most frequently adopted vary from 1 1-2 to 2 1-2 inches in diameter.

With a given velocity the weight of rope required for transmitting a given horse power will be the same, irrespective of the diameter of rope; the smaller rope will require more parts, but the weight will be the same. As we have stated, many engineers prefer to use a greater number of ropes over wide-faced pulleys, but in order to reduce the expense incident to a large number of grooves in the pulleys a closer margin is allowed on the smaller ropes, and in consequence the normal working strain on each rope is usually increased far in excess of that which would be necessary if the same weight of rope were employed as for the larger diameter. As a result of this, the small ropes are rapidly worn out and frequent renewals are necessary.

We are aware that small ropes are advocated and installed by many engineers, but we believe this to be wrong both in principle and practice. In rope driving the first cost and erection of small driving pulleys may influence a designer to use small ropes, but as ropes are sold by the pound, and as the weight necessary to transmit a given power should be the same, irrespective of the diameter, it is evident that the first cost of the rope itself will be the same, whether large or small ropes are employed. Moreover, if the pulley is suitably proportioned to the size of rope in each case, the smaller rope will last only about one-third as long as a rope twice its size, under similar conditions.

The wear of a rope is both internal and external; as we have previously noted, the internal wear is due to the bending of the fibres and their sliding upon one another, which produces a grinding action, very much increased when the strands are not lubricated or when a hard twist is given to the rope, thus preventing by the greater compression of the fibres upon one another that freedom of action which is so essential to the life of the rope. It is evident that a similar compression of the fibres will occur when a rope under tension is wrapped around a pulley; the greater this tension the greater also will be the compression and distortion of the fibres.

The external wear is due to the contact between the rope and the sides of the groove in which it runs, and is greatly increased when slip occurs; roughness in the groove also increases the wear, and for this reason the rim should be turned smooth and polished, as the outer fibres, rubbing on a rough-turned or cast surface, will gradually break, fibre by fibre, and thus give the rope a short life.

Contact between different ropes, or between a rope and some obstructing surface, such as a partition wall, post, or floor beam, is frequently the cause of a large portion of the external wear of a rope; this may be due to faulty construction or erection; pulleys designed with too small a pitch between the grooves, or running out of true, causing the ropes to vibrate and flop; or, as in outside work, a swaying, producing contact, may be set up in the ropes, due to the action of the wind.

With the same total stress in a rope, it may be assumed that the wear, both internal and external, increases directly with the number of flexures, the slip, and the surface in contact; and also that a reverse bending is more injurious to the rope than single bends in a constant direction. For a given speed the number of flexures and the actual surface in contact with the pulleys will decrease as the distance between centres increases, and hence the wear will vary inversely with the distance between centres of pulleys, but it must be noted that with imperfect construction an increased distance between shafts will favor swaying and rubbing of the ropes against each other and the edges of the grooves.

The number of flexures and the surface in contact will evidently increase directly as the velocity, and therefore the wear may be assumed to vary directly as the velocity of the rope. If we assume that two 1 1-4-inch ropes are necessary to transmit a given horse power, it will require eight 5-8-inch ropes to transmit the same power at the same speed and tension per square inch of section. If suitable pulleys are used in each case, the wear will be considerably greater with the smaller ropes. For the total external surface of the eight ropes in contact with the pulley each revolution is twice as great as that obtained with the 1 1-4-inch rope; moreover, the distance between centres of shafts will generally be considerably less with the smaller ropes, and as the number of revolutions of the smaller pulleys should be more than twice as great for the same speed of rope (since the pulleys are less than half the size of those used for the larger rope), the number of flexures and the wear of the rope on the pulleys will be greater with the 5-8-inch rope—for not only is each rope bent more than twice as many times per minute, thus producing eight times the bending in the smaller ropes, but, as the slip is independent of the diameter of the rope, it will be evident for the same proportional stress and arc of contact that the slip will be four times greater in the case of the smaller ropes, even if we neglect the differential driving effect which may be assumed to increase with the number of ropes.

Thus, it will be seen that under similar conditions and proportional stress, we should expect the smaller rope to wear out more than twice as fast as one double its size; and when the stress is proportionally greater in the smaller rope, as we ordinarily find it, the wear will be still greater.

These conclusions are borne out in practice, for in transmissions using small ropes 3-4 inch in diameter and under the life of the rope is usually only from six to twelve months; in many cases such ropes will last only three months, although others have been in active use for periods varying from one to two years.

On the other hand, the larger sized ropes, one inch to two inches in dimeter, will last from two to six years, and under favorable conditions large ropes have lasted eight and even ten years.

From an investigation of numerous examples of rope driving under a variety of existing conditions, the writer is led to believe that ropes less than 3-4-inch diameter should not be used if it is at all practicable to employ the larger sizes, and that ropes one inch in diameter and over are to be preferred where it is possible to use the larger pulleys which are necessary for such ropes.

With larger ropes the wear is not only much less, but, where the usual multiple wrap system is used, when a number of yarns give way the rope does not part at once if subjected to a greater or sudden tension, but may run until a convenient opportunity offers to shut down; whereas, with the small rope, having a greater number of wraps, when a

*Trans. A. S. M. E., 1891.

strand or a number of yarns give way, any increased stress due to imperfections in the system is liable to still further rupture the yarns in the weaker rope, and a sudden break or pulling out occurs.

Besides the greater life of the rope, and consequent less cost, the saving of time on account of fewer breakdowns and stoppages is a factor worth considering; and although this feature does not cut as much of a figure with rope driving as it does with factory belting, yet it is of such importance that many men would rather use some other form of transmission than suffer the annoyance incident to resplicing a broken rope every few months. While the time lost in repairing the rope or in laying down a new one may not be great in itself, the stoppage of a department in a busy season may prove to be a serious loss. Where foundries and isolated shops have been driven by small ropes, this has happened so frequently that the ropes have beeen taken out and replaced with shafting, or other more expensive method of transmission.

In order to avoid any serious loss of time or inconvenience due to a sudden rupture two independent ropes should be used, each having its own tension sheave and weight. This does not involve any more wraps than would otherwise be used for a single wind, for the normal working stress is in any case so much less than the actual strength that for a temporary run of a few hours, or even days, one rope could readily carry double its working load, in case the other should give out. When two independent ropes are thus used they may be wound separately, each wrap occupying successive grooves on the pulleys; or, which is more frequently the case, the ropes may be wound in parallel, thus bringing each rope in alternate grooves; in either case it is preferable to use an independent tightener, although a single-tension carriage, provided with two sheaves, may be used, but with this latter, owing to local causes and the difficulty of splicing both ropes of an equal length, the load is not as well distributed between the two ropes.

In subsequent considerations of the driving power of ropes, the relation between the ultimate strength, weight per foot of length, normal working strain, and the diameter of rope will be represented by the following equations, which have been determined for manilla transmission rope:

Let d = diameter of rope in inches.
w = weight of rope in pounds per foot.
S_1 = breaking strain.
t = normal working strain.
x = an empirical coefficient.

Then $w = 0.3216\ d^2$.
$S_1 = 100\ d^2\ x$.
$t^* = 200\ d^2 = b$.
$x = 81 - 9\ d$.

In determining the horse power which a rope will transmit under given conditions the centrifugal force due to the velocity and weight of rope is an important factor and its influence should be considered in all cases, for at high velocities this force diminishes the pressure exerted between the rope and the circumference of the pulley, thus reducing the friction between rope and pulley. When, therefore, a rope has to transmit a given force, P, it must be subjected to a greater tension the greater the centrifugal force, F_0. At a speed of about 90 feet per second the centrifugal force increases faster than the power from increased velocity of the rope, and at 140 feet per second this force equals the assumed allowable back tension in the rope; and since the transmitting force is equal to the difference in tension in the two parts of the rope, it will be seen that no power will be transmitted at this speed unless the assumed allowable tension be exceeded.

It is evident that for a given total tension the less back tension required to prevent the slip of the rope on the pulley the greater will be the power transmitted at a given speed.

The determination of this back tension is, however, attended with a degree of uncertainty, as there are no conclusive experiments which give reliable data for its calculation; the coefficient of friction, Φ, as stated by various authorities, varying all the way from 0.075 up to 0.88.

Reuleaux quotes the experiments of Leloutre and others as indicating a value of 0.075 for cylindrical pulleys with new hemp rope, 0.088 for semi-circular grooves and 0.15 for a wedge groove of 60°.

Experiments by the Messrs. Pearce Brothers, of Dundee, give a value of Φ equal to 0.57 to 0.88 for ropes on ungreased pulleys, and $\Phi = 0.38$ to 0.41 when the pulleys are greased.

Unwin states that the coefficient of friction for ropes on a flat metal pulley is equal to 0.28, from which the actual coefficient for a grooved pulley is obtained by multiplying 0.28 by the cosec. of half the angle of the groove. For an angle of 45° this would give $\Phi = 0.72$. These latter values are probably very much higher than is ordinarily found in actual practice with well lubricated ropes and moderate slip. From a consideration of various experiments and the conditions under which they were carried out, it would appear that for ropes which are partly worn and sufficiently greased to wear well with a low percentage of slip a value of 0.12 for a flat-surfaced, smooth-metal pulley will approach very closely to those conditions which obtain in average practice, from which the following working coefficients are obtained:

For a groove of 30° this would give

$$\Phi = 0.12 \text{ cosec } \frac{30^\circ}{2} = .46.$$

For a groove of 45° this would give

$$\Phi = .12 \text{ cosec } \frac{45^\circ}{2} = .31.$$

For a groove of 60° this would give

$$\Phi = .12 \text{ cosec } \frac{60^\circ}{2} = .24.$$

Besides varying with the angle of groove, as shown, the coefficient of friction is affected by the condition of the rope, and for dry ropes Φ may be taken somewhat greater than the above value; Φ will also be increased with an increased percentage of slip.

If the arc of contact on smaller pulley, the coefficient of friction between rope and sheave and the total tension in the rope be known, the tension on slack side of the pulley, and hence the horse power transmitted, can be readily determined from the following considerations:*

Assuming, as before, that the driving force, P, is equal to the difference in tension T_1 on the driving side of the rope and T_2 on the driven side, and noting that the driving force must equal the friction F between the surfaces, we obtain

$$T_1 - T_2 = P = F.$$

The friction, F, depends upon the arc of contact α between the rope and its sheave, the coefficient of friction Φ and upon the centrifugal force F_0, set up in the rope, due to its velocity and weight; it is, however, independent of the diameter of pulley. To determine the values of F, T_1 and T_2, it will be necessary to assume a given tension in the rope; also its speed and weight, coefficient of friction and arc of contact.

*On account of the relatively great difference between S_1 and t, it is not thought advisable to consider the increase in strength of the smaller ropes, as in any case the difference would be very slight, and, moreover, it must be noted that t is the normal estimated strain, and may vary considerably from the actual strain.

*Weisbach, volume III., page 254. See also Reuleaux.

Let f = friction between element of rope and pulley.
g = acceleration due to gravity = 32.16.
p = normal pressure on pulley.
t = allowable working tension = 200 d^2 pounds.
v = velocity of rope in feet per second.
w = weight of rope per unit length and area = 0.3216 d^2 pounds per foot.
z = abbreviation for $\frac{w}{g}\frac{v^2}{t}$.
A = area of cross-section of rope.
F_0 = centrifugal force.
P = driving force = $T_1 - T_2$.
R = radius of pulley.
T = tension in rope at any point.
T_1 = tension in rope on tight side.
T_2 = tension in rope on slack side.
α = least arc of contact between rope and pulley—circular measure.
Φ = coefficient of friction.

If in Fig. 29 T is the tension in the rope at any point, D,

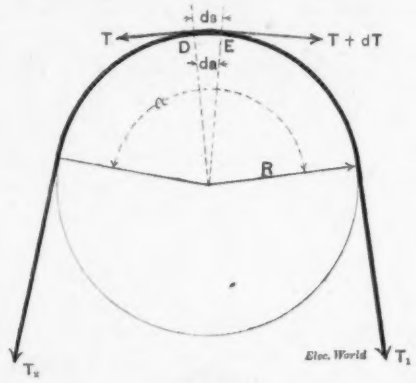


FIG. 29.

then the tension in the point E, whose distance from D is ds, will be $T + dT$. Assuming f to represent the friction on the element DE, we shall have $f = dT$ when the several forces are in equilibrium. Since the friction is dependent upon the normal pressure p exerted by the element upon the rim of the pulley, and since this normal pressure is diminished by the centrifugal force due to the weight and velocity of the element, we shall have $dT = \Phi(p - F_0)$.

Now p is the resultant of the two forces T and $T + dT$; hence

$$p = T \sin\frac{d\alpha}{2} + (T + dT)\sin\frac{d\alpha}{2},$$

which may be assumed equal to $T\,d\alpha$ on account of the smallness of $d\alpha$ and dT.

The centrifugal force of the element of the rope is

$$F_0 = w\,A\,\frac{v^2}{R\,g}\,ds = w\,\frac{T}{t}\,\frac{v^2}{R\,g}\,ds;$$

and since $ds = R\,d\alpha$, we have

$$F_0 = w\frac{T}{t}\,\frac{v^2}{R\,g}\,R\,d\alpha = w\frac{T}{t}\,\frac{v^2}{g}\,d\alpha;$$

substituting these values of p and F_0 in $dT = \Phi(p - F_0)$, we obtain

$$dT = \Phi\left(T\,d\alpha - w\,\frac{v^2}{g}\,\frac{T}{t}\,d\alpha\right).$$

For convenience let $z = \frac{w}{g}\frac{v^2}{t}$, then

$$dT = \Phi\,T(1 - z)\,d\alpha, \quad \text{or} \quad \frac{dT}{T} = \Phi(1 - z)\,d\alpha.$$

Integrating,

$$\int_{T_2}^{T_1}\frac{dT}{T} = \int_0^{\alpha}\Phi(1 - z)\,d\alpha,$$

hyp. logarithm

$$\frac{T_1}{T_2} = \Phi(1 - z)\,\alpha,$$

hence

$$\frac{T_1}{T_2} = \varepsilon^{\Phi\alpha(1-z)} \text{ or } T_1 = T_2\left[\varepsilon^{\Phi\alpha(1-z)}\right],$$

in which ε is the base of the hyp. log. = 2.7183, therefore,

$$T_1 - T_2 = P = T_2\left[\varepsilon^{\Phi\alpha(1-z)}\right] - T_2 = T_2\left[\varepsilon^{\Phi\alpha(1-z)} - 1.\right]$$

If we assume $\frac{T_1}{T_2} = r$, there is obtained

$$\frac{r}{r-1} = \frac{T_1}{T_1 - T_2} = \frac{T_1}{P}.$$

These ratios, r and $\frac{r}{r-1}$, Reuleaux calls the friction modulus and the stress modulus respectively.

As the common logarithm of ε is 0.43430, the value of r may be more readily obtained from common log. r = 0.4343 $\Phi\alpha(1 - z)$; if the arc of contact is given in degrees, α = 0.0175 $\alpha°$, which gives the common log. r = 0.4343 × .0175 $\alpha°$. $\Phi(1 - z)$ = 0.007578 $\Phi\alpha°(1 - z)$. As the weight of a manilla rope one foot long = 0.32 d^2 pounds, the value of z for varying speeds can be determined from

$$z = \frac{w\,v^2}{g\,t} = \frac{0.01\,d^2\,v^2}{t};$$

if now we assume a constant working stress t = 200 d^2 pounds, then

$$z = \frac{0.01\,d^2\,v^2}{200\,d^2} = 0.00005\,v^2.$$

(To be continued.)

Patent Office Abuses.

The Patent Commissioner recently said that the public has a very slight appreciation of the number of attempts that are made to get patents not based on valuable inventions, but which offset under cover of a slight change a meritorious invention made by another and already patented. It is the constant experience of the office that when a really valuable invention is made and the patent therefor issued and published, a score of applicants will come in for patents on trivial and unmeritorious details with the purpose of meeting the true invention with another patent on substantially the same thing.

Commenting on the same subject, a patent attorney said that a patent was granted some time ago for a paper band to secure a package of money, having the amount of the contents printed on it in different directions, so that the amount might be read, no matter in which position the package was held. This patent was sought to be withdrawn by the Commissioner of Patents. "The majority of the examiners are only fairly liberal, and some are not liberal enough, and the result of such instructions as have been given them by the Commissioner has been, and will be, till modified, to cause the least liberal examiners to be less so, and those who have pursued a fair and just course, too, feel that they must submit their judgment to the views they understand the Commissioner as holding. That there shall be a modification of the order that has been given to the examiners there can be no doubt, and the sooner it is made the better, for no inventor can now know what ground he has to stand on."

Berlin-Cologne Telephone Trunk Wire.

According to the London "Electrician" the telephone trunk wire between Berlin and Cologne (300 miles) is now open to the public. Three minutes' conversation costs one mark (24 cents). Urgent messages, which are to take precedence of ordinary ones, are charged for at treble rates.

THE ELECTRICAL WORLD'S DIGEST OF CURRENT TECHNICAL ELECTRICAL LITERATURE

COMPILED FROM THE PRINCIPAL FOREIGN ELECTRICAL JOURNALS. BY CARL HERING.

ELECTRO-PHYSICS.

Relation of Electrostatic Capacity and the Coefficient of Self-Induction.—"Electricite," Jan. 25, reports an Academy paper by Mr. Potier, in which he demonstrates a theorem, the conclusion of which is that the electrostatic capacity and the coefficient of self-induction are inverse functions, or, in other words, in absolute units their product is equal to unity in a conducting system in which one part envelops the other and which constitutes a complete circuit.

Electrical Heating in Physical Researches.—The Lond. "Elec. Rev.," Feb. 2, in calling attention to Prof. Nichols' recommendation to adopt electric heating for obtaining steady temperatures, suggests that there is nothing better than an incandescent lamp for this purpose, it being much better than a wire; it also suggests that hot, thin filaments may come into use for obtaining spectra, in which case no slit would be required and great brilliancy ought to be obtained.

Oscillographic Methods.—In "La Lum. Elec.," Jan. 27, Mr. Blondel refers to a recent paper by Prof. Nichols on "Phenomena of the Time-Infinitesimal" (an abstract of which is published in the London "Electrician," Jan. 5), and states that the oscillograph was described and invented by him, Blondel, a year ago; he gives a short description and adds a few new details.

Luminous Discharges in Electrodeless Tubes.—The Lond. "Elec. Rev.," Feb. 2, calls attention to a Physical Society paper by Mr. Rimington in the October number of the "Proceedings," in which he treats the subject mathematically and experimentally, arriving at the same conclusions that he did a year ago.

Effects of Light on the Electrical Discharge.—The Lond. "Elec.," Feb. 2, reprints from "Nature" a short but apparently complete summary of the work done in this direction.

A Fundamental Error in Laplace's Formula.—The "Elek. Anz.," Jan. 21, contains an article by Mr. Schwartze, in which he describes what he believes to be an error. Among other things he calls attention to the confusion caused by the so-called electrostatic and electromagnetic systems of absolute units; he states that a definite proof of the correctness of Laplace's formula is needed; magnetism and electricity, he claims, depend on surface actions; the former represents the statics and the latter the dynamics of the "gravimotoric" field of force; Laplace's error is claimed to lie in the fact that he defines the conception of force by MLT^{-2} without considering the true nature of the force; but this formula, however, he claims is wrong, as it contains the factor acceleration; it is also wrong, as Biot and Savart have shown experimentally that the surface action between the magnet pole and a conductor of electricity is proportional simply to the first power of the distance; in conclusion, he adds that the correct formula leads to the same results as the incorrect Laplace formula, and that the use of the latter is therefore not incorrect; the difference lies in the more simple expression for current, namely MLT^{-1}.

Force and Work.—The "Elek. Anz.," Jan. 28, contains an article by Mr. Schwartze on this subject, in which he discusses the coefficient k in the formulas of Coulomb and Laplace.

Electromotive Forces of Polarization.—An article from "Zeit. Phys. Chem.," by Mr. Leblanc, is abstracted briefly in the Lond. "Elec. Eng.," Feb. 2.

Electromotive Forces of Insoluble and Complex Salts.—The Lond. "Elec. Eng.," Feb. 2, abstracts briefly from the "Zeit. Phys. Chem." an article by Mr. Zengelis on this subject.

Dielectric Constants of Biaxial Crystals.—Mr. Borel's article on this subject is concluded in "La Lum. Elec.," Jan. 27; the results of his measurements are summarized in a table.

Stationary Electric Waves.—An article by Mr. Salvioni is published in "La Lum. Elec.," Jan. 27.

MAGNETISM.

Law of the Magnetization of Soft Iron.—"L'Elec.," Jan. 27, abstracts an Academy paper by Mr. Joubin; if I is the intensity of magnetillation, H the field, K the susceptibility, such that $I = K H$, and a curve is drawn with I as ordinates and K or $4 \pi K$ as abscissas, he states that the curve is an exact parabola, except in the neighborhood of the origin. This curve has a striking resemblance to that for the density of saturated fluids, as a function of temperature, the latter being analogous to the susceptibility; the same relation is said to exist between the superficial density I and the susceptibility K as between the density and the temperature of the fluid; the same formula may therefore be used with both.

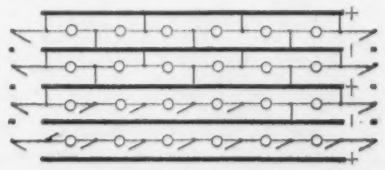
Magnetic Permeability of Oxygen.—A paper from "Wied. Ann.," by Mr. Hennig, is abstracted in the Lond. "Elec.," Feb. 2; the results for various pressures and temperatures, as also a comparison with the other determinations, are given; the paper is discussed editorially.

Earth's Magnetism.—"L'Ind. Elec.," Jan. 25, and "L'Elec.," Jan. 27, publish the constants as measured at the Observatory, near Paris. The author endeavors to determine the relation which exists between the number of storms and the declination of the moon.

Compass Regulations by Observations of the Horizontal Component.—"L'Ind. Elec.," Jan. 25, abstracts briefly an Academy paper by Mr. Cornu, in which is described how the necessary coefficients are determined.

UNITS, MEASUREMENTS AND INSTRUMENTS.

Rheostats of Lamps.—A paper by Mr. Heim is reprinted in the "Elek. Zeit.," Jan. 25, in which he describes rheostats made of lamps, chiefly for laboratory purposes; as will be seen from the adjoining cut, which is one of seven,



RHEOSTATS OF LAMPS.

the lamps, represented by circles, are connected in four groups of six in each series; at each junction between two lamps and also at each end there is a lever switch; between each row are strips of metal, shown in heavy lines, which are alternately connected to the positive and negative ends of the circuit; any of these may also be disconnected from that circuit; as will readily be seen, an almost innumerable number of combinations can thus be made from all in parallel to all in series, the one shown in the figure being a combination of some in series with some in multiple arc. A detailed description for a battery of 56 lamps in eight rows of seven each is also given. (The arrangement is ingenious and simple, but appears to have this objection, that a single incorrectly placed switch may make very great differences and may even cause the immediate destruction of a number of lamps.)

Kruppin, a New Resistance Material.—The article abstracted in the Digest Jan. 6 (see also Feb. 3) is abstracted very briefly in the Lond. "Elec.," Feb. 2, in which a table is given for the specific resistance and the current capacity of spirals, for various sizes of wire.

Electrostatic Voltmeters.—Swinburne's new voltmeter is illustrated and briefly described in the Lond. "Elec.," Feb. 2; it consists essentially of a quadrant electrometer.

Determining the Conductivity of Dielectric Liquids.—The article mentioned in the Digest Jan. 30 is reprinted in "La Lum. Elec.," Jan. 27.

DYNAMOS AND MOTORS.

Multiphase Motors.—In the "Elek. Zeitft.," Jan. 25, Mr. Steinmetz discusses briefly the history, the theory and the construction of induction multiphase motors. An abstract, which is too lengthy to be given here, will be found in another column of this issue.

Experiments with Brown Non-Synchronous Motors.—The tests of Mr. Banti are concluded in the Lond. "Elec. Rev.," Feb. 2; this description seems to be more complete than that from which our first abstract was made.

Irregularities in the Action of Dynamos.—Mr. Montpelier's serial is concluded in "L'Elec.," Jan. 27. The reprint in the Lond. "Elec. Eng." is continued in the issue of Feb. 2.

Dynamo Attendants and Their Dynamos.—The serial under this heading is continued in London "Electricity," Jan. 19 and 26.

Iron in Armatures.—Our attention has been called by Mr. Wiener to a typographical error in the abstract under this heading in the Digest, Jan. 20; the last figure should read 28 degrees instead of 48. From the rest of the abstract it will have been noticed that this must be a typographical error, the article itself showing that the rise of temperature is less for thin than for thick plates.

ARC AND INCANDESCENT LIGHTS.

Candle Power of Search Lights.—Under the heading of "A Reform in Photometry" Mr. Guilbert publishes an article in "La Lumiere Electrique," January 27, in which he discusses a recent article in which it was claimed that the intensity remained constant up to a certain distance, after which it varied according to the law of the inverse squares; he claims that this is an error, and that the intensity diminishes continuously; there is no interest attached to the intensity at small distances, as such apparatus are used only for great distances; he defines the term luminous power as the intensity of a naked light, which, when placed at the same point, produces at great distances an intensity equal to that measured on the axis of the beam of the search light; this definition, he claims, is correct, because such lights are used only at great distances; he states that all the experimental determinations which have been made in France and elsewhere were made at distances which were greater than the (minimum) limit of the application of the law of inverse squares, and consequently are in perfect accord with the definition; in conclusion, he states that there is really no ground for discussion nor for the proposed reform.

The Goebel Lamp Story.—The Lond. "Elec. Rev.," Feb. 2, contains an article by Mr. Tanner, in which he quotes from the New York "Electrical Engineer" regarding the history and work of Goebel. In order to establish the truth or falsity of this story he visited the Hanover school, where Goebel's friend, Prof. Moenighausen, was supposed to have been, and was told by Prof. Ruehlmann, who has been a professor in that school since 1840, that no such professor was ever known in the kingdom of Hanover, nor had anything ever been heard regarding the experiments with electric light at Hanover in the early forties; he did not think it probable that they would have escaped his notice if they had ever been made. Prof. Ruehlmann thinks it probable that Goebel evolved all his alleged experiments out of his inner consciousness, and that they have no foundation in fact. Mr. Tanner next visited Goebel's home at Springe, where he met some friends of Goebel, who stated that he was no watchmaker nor optician, but was chiefly engaged in selling and repairing clocks; they also said that they had never heard of a Prof. Moenighausen; a visit to his cottage showed that it was unlikely that he ever built any machines there; his father never served as consul of the Netherlands at New York, being a gardener by profession. (Mr. Tanner also refers to Prof. Moenighausen as "Muenchhausen," a character of fiction, who, in German literature, is always credited with doing the most impossible things.)

Maximum Efficiency of Arc Lamps with Constant Number of Watts.—Referring to the question which arose at the Chicago Congress, a note in "L'Elec.," Jan. 20, describes briefly a method, and states that a maximum was obtained in the neighborhood of 900 c. p. for 54 to 55 volts and 8.4 amperes; for 10 amperes and 45 volts it was 450 c. p.; for 500 watts at 9 amperes and 55 volts the intensity was 1,200 c. p. It suggests that a similar series of experiments should be made with alternating arc lamps.

Auer-Welsbach Incandescent Gas Light.—According to a report from Athens in the "Elek. Zeitft.," Jan. 25, it was found that the introduction of this burner first diminished the number of lamps connected to the electric central station, but that after a short time these were again replaced with electric lights; the journal adds that the same experience was had in the city of Cologne.

Automatic Railroad Lamps.—The Lond. "Elec. Eng.," Feb. 2, gives a description, with illustrations, principally of the architectural features, of the charging station of the company providing such lamps in London.

Arc Lamps.—"L'Elec.," Jan. 20, gives an illustrated description of the Church lamp, in which the arc is fixed in position and the mechanism is operated by a vibrator; the lamp of Stekelorum and Mangin is operated by a brake acting on a train of gears.

Manufacture of Incandescent Lamps.—The illustrated serial in the "Elek. Anz." is continued in the issue of Jan. 28.

Cored Carbon Litigation.—The "Elek. Echo." Jan. 27, reprints at some length a communication on this subject.

TRANSMISSION OF POWER.

Mechanical and Electrical Transmission.—In the article in "Rev. de L'Elec.," Jan. 31, on "Central Stations in Belgium," it is shown that the cost of transporting electrical energy is 36 times as great as the cost of its production, from which it is concluded that it would be more economical to produce mechanical energy at a single point outside of the city, to transmit it as such, and to transform it into electricity in a large number of places near the points of consumption; calculations substantiating this are promised in a subsequent

article. (This system appears to be that proposed by Van Rysselberghe, mentioned in the Digest Oct. 7.)

Transmission of Power at Chambery.—A note in "L'Ind. Elec.," Jan. 25, states that the waterfall for this plant is 2,040 feet high, furnishing about 2,000 h. p., and is situated about 11 miles from the city; there will be seven alternators, each of 120 kilowatts at 5,000 volts, two of which act as reserves; the loss in the line will be less than 10 per cent., and the transformation down to 110 volts takes place through transformers of 10 kilowatts each; it is to be started next May. No mention is made of the kind of hydraulic machinery which is to be used for such an enormous pressure.

Transmission of Power at Lyons.—A short description of this installation is given in "La Lum. Elec.," Jan. 27.

ELECTRIC RAILWAYS.

High-Speed Railroads.—"L'Ind. Elec.," Jan. 25, abstracts an address before the French Society of Civil Engineers by its president, Bousquet, in which high speeds are discussed and some figures calculated for ideal steam locomotives, a deduction from which is that at 200 kilowatts (about 160 miles) per hour, the weight of the locomotive and the power would become infinite. The paper refers to steam locomotives only.

Application of Electricity to Public Works.—"La Lum. Elec.," Jan. 27, gives an illustrated description of the application of electricity in the construction of the new harbor works at Bilbao, Spain, in which huge blocks of stone, weighing 100 tons, were transported by a specially constructed crane, traveling on rails and operated electrically.

Regulations.—The Lond. "Elec.," Feb. 2, discusses editorially the meeting of the Traction Committee, at which the proposed regulations of the Board of Trade were discussed. The Lond. "Elec. Eng.," Feb. 2, also discusses this subject at some length.

Blackpool Railway.—A summary of the reports on the Blackpool Railway, in which a slotted conduit is used, is given in the Lond. "Elec." Feb. 2. The report is contained also in the Lond. "Elec. Eng.," Feb. 2, where it is also discussed editorially.

Generators for the Saleve Railway.—The "Elek. Anz.," Jan. 21, publishes a good illustration of the large horizontal dynamos with external fields.

Bordeaux-Vigean.—"L'Elec.," Jan. 20, gives an illustrated description of this railway, installed by the Thomson-Houston company.

CENTRAL STATIONS, PLANTS, SYSTEMS AND APPLIANCES.

Central Stations in France.—"L'Ind. Elec.," Jan. 25, publishes as a supplement a long list of all the central stations for the distribution of electric energy in France on the 1st of January, 1894; tabulated information is given in each case, the table being more complete in this respect than such tables usually are; the city of Paris is not included. A map of France accompanies it, on which are marked the locations of all the stations, different marks being used for distinguishing between alternating and direct current plants. Six months ago, when a similar table was published, the number of stations was 255, while at present it is 301; the total horse power is 38,200, of which 9,259 is furnished by water power alone, 6,000 by water and steam power combined, 21,820 by steam power and the rest by gas. Of all the stations 136 are operated by hydraulic power, 113 by steam power, 36 by steam and hydraulic power, 3 by power gas and 13 by municipal gas; 248 are continuous-current stations, 47 alternating and 6 continuous and alternating combined. A number of important stations are to be started in which power gas and polyphase currents are to be used; 115 stations are projected and in course of construction.

Polyphase Installation in 1893.—"L'Ind. Elec.," Jan. 25, gives the following summary of installations at present in operation: France, 3 installations of triphase currents; St. Etienne, Pont-Lignon and Florensac, all like the installation at Lauffen-Heilbron; Germany, 4 installations, also with triphase currents, Lauffen-Heilbron, Bockenheim-Frankfort, Erding and Wangen; Austria, 2, Pergine with three-phase and Budapest with two-phase currents; America, one at Redlands, Cal.

High vs. Low Voltage.—An editorial in the Lond. "Elec. Rev.," Feb. 2, discusses this subject, but without apparently giving anything new; it quotes Mr. Ferranti as saying "the electric light industry would be benefited if pressure were higher and the cost lower": regarding accumulators, it states that although most continuous-current stations have a battery, few of them seem to make use of it, spare steam power seeming to be preferred for meeting extra demands. "The benefits of storage, when carried out on a large enough scale, are evidently very great, but it must be on a scale to enable the supply to be made almost wholly from the batteries, using the machinery and running it continuously for charging only." If the voltage of the lamps could be doubled and the current halved, the mains would carry current for twice the supply; (this statement seems to us to require some modification; unless the mains are used near to their heating limit, which they generally are not, except in the case of short mains, double the voltage would increase the carrying capacity fourfold, assuming, as is generally done, the same percentage loss.)

Direct vs. Rope Driving.—In a communication to the Lond. "Elec. Rev.," Feb. 2, Messrs. Willans & Robinson show that a recent statement made by Mr. Ruddle, that there was about as much rope or belt driving as direct driving in England, is not correct; they claim that the proportion is far greater in favor of direct driving. The subject is also discussed editorially in the Lond. "Elec.," Feb. 2.

Accepting the Lowest Bids.—An editorial in the Lond. "Elec. Rev.," Feb. 2, on "A Main Consideration," discusses the bad policy of accepting the lowest bids, calling attention to the importance of the insulation of the mains and the absorbent action of poor insulating material, which causes trouble at the joints.

Luminous Fountains.—The "Elek. Anz.," Jan. 28, gives an illustrated description of the Engelsmann system, in which no expensive underground construction is required; a system is illustrated in which 12 radial jets are illuminated internally by the use of only three lamps.

Liverpool Stations.—The Lond. "Elec.," Feb. 2, abstracts a paper by Mr. Holmes on the distribution from a commercial standpoint.

London.—The station of the Metropolitan Company is described in "L'Elec.," Jan. 27.

Motive Power and Gearing.—In Mr. Carter's serial in the Lond. "Elec.," Feb. 2, he discusses the subject of fuels.

WIRES, WIRING AND CONDUITS.

Gutta-percha and Rubber Cables.—The Lond. "Elec. Rev.," Feb. 2, quotes from the "India Rubber World," in which a writer states that gutta-percha is best for deep-sea cables, while rubber is best for rivers and harbors; the best cable should be made with gutta-percha inside and rubber outside, so as to protect the wire from the sulphur and the gutta-percha from the atmosphere.

Wiring Light on Shipboard.—The Lond. "Elec. Rev.," Feb. 2, comments on fires caused by bad wiring, especially by bad joints, and states that nothing but armored cables are good enough for ship work, jointed by properly designed cast-iron boxes, made water tight, in which case the wires cannot possibly cause a fire. The Lond. "Elec. Eng.," Feb. 2, also discusses this subject.

TELEGRAPHY, TELEPHONY AND SIGNALS.

Telegraphy and Telephony of the World.—The Lond.

"Elec. Rev.," Feb. 2, quotes from the "Jour. Teleg.," giving the statistics for 1892 and 1893; for the latter they were as follows for telegraphs: Total length of line, 1,661,300 kilometres; submarine cables, 250,000; total length of wire, 4,910,070; total number of messages, 336,052,000, providing a revenue of about $100,000,000; in 1892 the telephone systems had a total length of wire of 972,113 kilometres, over which 982,387,416 conversations took place; Great Britain is not included in this summary; the number of conversations in America is about two-thirds of the total; Switzerland and Sweden are best in the number of subscribers per population, which are 5 and 5.82 per thousand respectively, the general average for the world being 1 per 800.

French Cable Enterprise.—The Lond. "Elec.," Feb. 2, discusses recent French cable enterprises, giving maps of the proposed cables joining the West Indies with South America; also of the cables on the east coast of Africa.

Pacific Cables.—Lond. "Elec.," Jan. 19, contains a short article by Mr. Hancock.

Railroad Signals.—Mr. Teirich in the "Elek. Zeitft.," Jan. 25, describes a system with an automatic danger signal in case of breakage of the wires.

Telephone Receivers.—An illustrated description of an improved receiver is given in the Lond. "Elec. Eng.," Feb. 2.

Interchangeable Telephone Switch.—Lond. "Elec.," Jan. 19, describes and illustrates the Sloper switch.

ELECTRO-CHEMISTRY.

Electro-Zincing Process.—In the Lond. "Elec. Rev.," Feb. 2, the Cowper-Coles process of plating or galvanizing large steel plates by a cold process is described and illustrated; the installation is capable of coating plates 18 feet long; it is claimed that the cost is very much cheaper than the usual hot galvanizing, being about half in the case of plates, and as the process is a cold one, there is no distorting or warping, nor diminution in the strength of the steel; the current density used is 50 amperes per square foot; a table gives the results of tests of the tensile strength of various pieces before galvanizing, after hot galvanizing and after being zinc plated, the tensile strength in the latter case being in all of the three specimens appreciably greater than that for the hot galvanized steel; while the zinc on galvanized steel peeled off on stretching, that on the plated steel remained intact; no further information is given.

Electric Production of Varnish.—According to "La Lum. Elec.," Jan. 27, the Pfanne process is as follows: An electric current is passed for two or three hours through an intimate mixture of pure linseed oil, water and sulphuric acid; it is necessary to agitate the mixture continually, which is done by an agitator turning alternately in different directions; the agitator is connected to one pole and the vessel to the other; no further information is given.

Copper Baths.—The note under this heading in the Digest, Feb. 10, appears to have been based on an incorrect report. According to the "Elek. Zeitft.," Jan. 25, Dr. Langbein's improvement consists in the use of cuprocupricsulphite in place of the usual salts, and it is with this that he obtained the result that not even a trace of cyanogen is given off; the salt is soluble in cyanide of potassium, but not in water.

Electro-Chemical Cementation.—The Lond. "Elec. Rev.," Feb. 2, mentions briefly a method of Mr. Conedara, whereby the copper may be separated from solutions by means of iron electro-chemical cementation.

Dry Cells.—The serial of Mr. Zacharias is continued in the "Elek. Anz.," Jan. 21; a reply is published in the issue of Jan. 28.

MISCELLANEOUS.

Lightning Rods.—An article in the "Rev. de l'Elec., Jan. 31, calls attention to the difficulty of proving by statistics whether or not lightning rods should be used; belief is expressed that lightning rods do protect and that a bad one is better than none, the protection being better the better the rod is constructed; a number of cases are cited; in one there was a very bad lightning rod, and yet it protected a building during a certain storm; it is argued that if it had been good there would have been no bolt of lightning; in some cases buildings with rods were protected while those without and in the neighborhood were destroyed; in the case of a certain church one spire was protected, while some of those having no rods were destroyed; in the case of vessels, those in which the masts are metallically connected with the iron hull have never been struck, while wooden ones have; the damage done by lightning in Germany amounts to from two to two and one-half million dollars per year. It quotes Lord Kelvin as having said that in Scotland it is cheaper to insure a building than to furnish it with lightning rods.

Starch.—According to "La Lum. Elec." Jan. 27, Mr. Schaeffer has issued a report on different samples of fecules purified by the Siemens & Halske process of transforming the ordinary fecule of commerce into more soluble products, which are whiter and have no odor; the process, according to "La Nature," consists chiefly in a treatment by electrically generated ozone; all the samples were perfectly white and had greater thickening power than the finest fecule of commerce, and the starches made with these do not change in five days, while those made by the ordinary process liquefy in 24 hours; no information is given regarding the cost of the process.

Electricity in Plant Growth.—The Lond. "Elec. Eng.," Feb. 2, gives a brief account of a long series of experiments by Dr. Romanes on mustard seedlings exposed to constant electric light and to interrupted flashes, respectively, and he finds that the heliotropic influences of sparks or flashes is greater than can be produced by any other light; a strange feature was that his remarkable results were not accompanied by the formation of any particle of chlorophyl.

Flying Machines.—The "Elek. Tech.," Jan. 15, mentions that the Austrian Society of Engineers and Architects is about to undertake to construct the machine proposed by Prof. Wellmer. The wheel is to be 5 metres in diameter and 2 metres wide, and to have the required speed (peripheral?) of 45 metres per second; it is to be driven electrically or by steam; either the direct force will be measured or it will be so arranged that it will propel itself up into the air.

Healing Frozen Noses.—In an abstract in the "Elek. Echo," Jan. 27, Dr. Helbing has been successful in twenty cases, the treatment being to apply both poles to opposite sides of the nose and to pass a moderately strong current for five or ten minutes, moving the electrodes about; the immediate result is a reddening of the tissues, which may last several days; in some cases ten to fifteen applications are necessary.

Central Station Currents in Therapeutics.—An abstract of Mr. Gaiffe's paper, mentioned in the Digest last week, is given in the Lond. "Elec. Rev.," Feb. 2.

Corrugated Coverings.—The "Elek. Zeitft.," Jan. 25, gives an illustrated description of a new form of corrugated pasteboard, resembling the outline of a dove-tail joint, which is used as an insulating material and for the protection of telegraph poles where they are inserted in the ground.

Mechanical Applications.—Mr. Richard's well-illustrated serial is continued in "La. Lum. Elec.," Jan. 27, in which a number of applications are described.

Biographical.—"L'Ind. Elec.," Jan. 25, publishes a biography of Heinrich Hertz by Mr. Guillaume, in which he gives chiefly a short resume of the work done by this physicist. The "Rev. de L'Elec.," Jan. 31, reprints from the

"Jour. de Geneve" a brief description of his important work in electrical researches; among all those published recently this is the best brief description of the researches which made him famous.

Educational.—The "Elek. Zeitft.," Jan. 25, gives a report of a course of instruction in electricity in a trade school for mechanics.

From the Convention City.

I CONSIDER THE ELECTRICAL WORLD almost indispensable to any one who wishes to be well informed. I hope I may never be deprived of reading its very interesting and instructive pages.

F. D. NEALE,
Washington, D. C. R. and P. Division, War Dep't.

Praise from the Dominion.

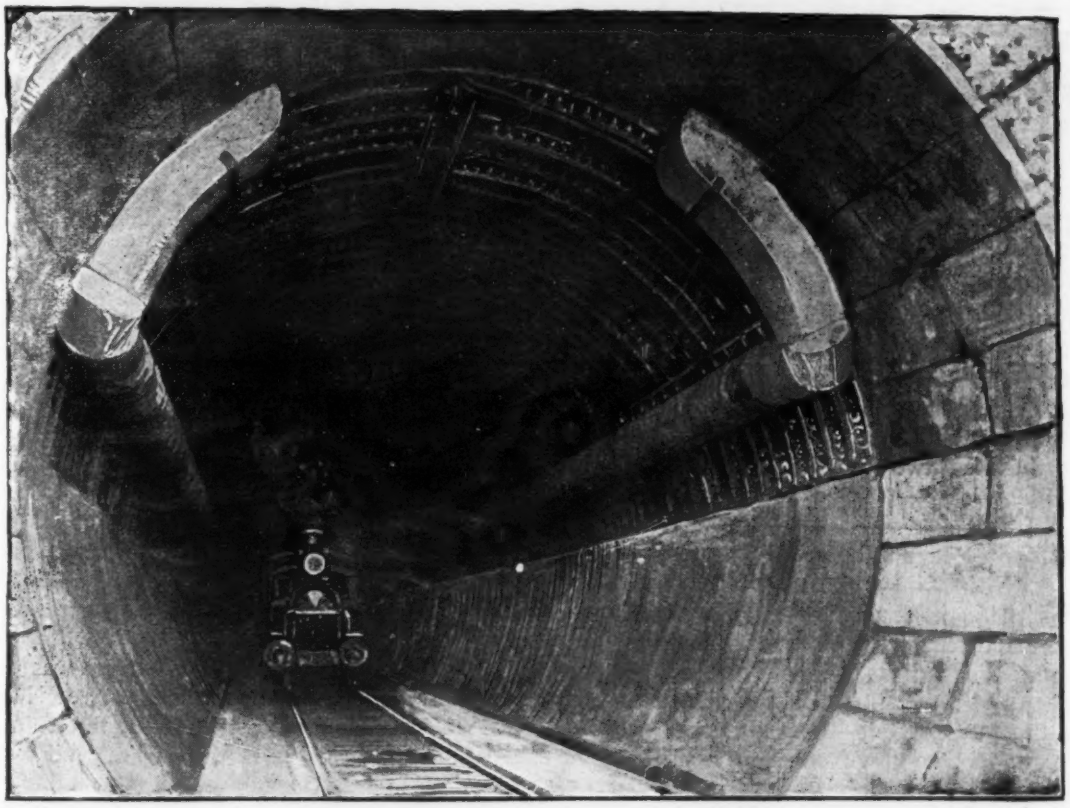
The existence of such a remarkable journal as The Electrical World is significant of the enormous development of electrical interests in the United States within the last dozen years. The contents of the present issue are of such variety and scope as to lead to the belief that all departments of electrical work, whether power, light, heat or communication, are within its grasp. And not only this, but the various subjects are treated in a manner and with an ability which merits high praise. Besides the editorials there are papers by Prof. Elihu Thomson, W. A. Rosenbaum, W. Stuart-Smith, Townsend Wolcott, and the "Digest of Current Technical Literature" is a valuable resume of European thought and experiment. The paper has correspondents in London, England, and in Canada.—Monetary Times, Toronto, Can.

Storage Battery Traction.

In an article under the above caption in our issue of Feb. 3, it is stated, explanatory of an estimate of cost of operation, that the data there given which were not directly determined by experiment had been taken from a report by Mr. Charles Hewitt. It should have been more clearly specified that the items referred to were deduced from information in Mr. Hewitt's report, and are those relating to the cost of power, repairs to motors, oil, waste and packing. Mr. McDougall merely availed himself of valuable general data contained in the report relating to these points, and for any other implication unintentionally conveyed the writer of the article, and not Mr. McDougall, is responsible. We have thought that this explanation is due both to Mr. Hewitt and to Mr. McDougall.

The St. Clair Tunnel.

The Grand Trunk Railway, in order to establish communication between Sarnia and Port Huron, constructed an immense tunnel under the St. Clair River, which is one of the finest examples of engineering work in this country at the present day. The length of the tunnel proper is 6,025 feet, and of the portals that form the approaches 5,605 feet additional, or more than two miles in all, being the longest



INTERIOR OF THE ST. CLAIR TUNNEL.

submarine tunnel in the world. It is a continuous iron tube 19 feet 10 inches in diameter, put together in sections as the work of boring proceeded and firmly bolted together, the total weight of iron aggregating 56,000 pounds. The tunnel commenced in September, 1888, was opened for freight traffic in October, 1891, and passenger trains began running Dec. 7, 1891. Work was commenced at both ends, the two sections meeting in mid river with perfect accuracy. The tunnel passes through blue clay, except an occasional pocket of quicksand and water and a few boulders. Borings were made by cylindrical steel shells, with cutting edges driven forward by hydraulic rams.

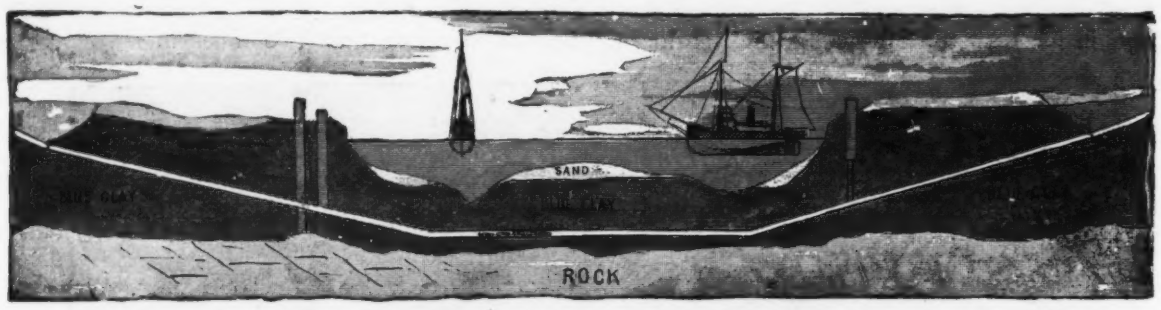
One of the accompanying illustrations gives some idea of the course of the tunnel and the steep grades on either end.

The rails of the track rest on a bed of brick and concrete, filling the bottom of the tubing. The engines, built by the Baldwin Locomotive Works, used to pull trains

through the tunnel and up the steep grade, are the largest in the world, having ten driving wheels and weighing nearly 200,000 pounds, with cylinders 22 inches in diameter, with a 28-inch stroke.

The cost of the tunnel was $2,700,000. Four thousand cars can be daily moved through it, which shows its immense superiority over the old ferry. The enterprise was promoted by Sir Henry Tyler, of England, president of the Grand Trunk Railway, assisted by Sir Joseph Hickson, late general manager. The engineers were Joseph Hobson, chief; T. E. Hillman, first assistant, and M. S. Blakelock, second assistant. Electric lights were employed for illumination during the construction, the plant being furnished by the Edison Company on the American side and the Ball Electric Light Company on the Canadian side.

The Great Northwestern Telegraph Company of Canada was obliged to carry its lines through this tunnel, and this large contract for cables was secured by the enterprising American firm of W. R. Brixey, New York City. Six thousand feet of 18-conductor aerial kerite cable was required for this purpose, and it is stated by the Great Northwestern company that in spite of the severe test to which it has been subjected during the past two years it has given perfect satisfaction.



SECTION OF ST. CLAIR TUNNEL.

Street Car Storage Heating System.

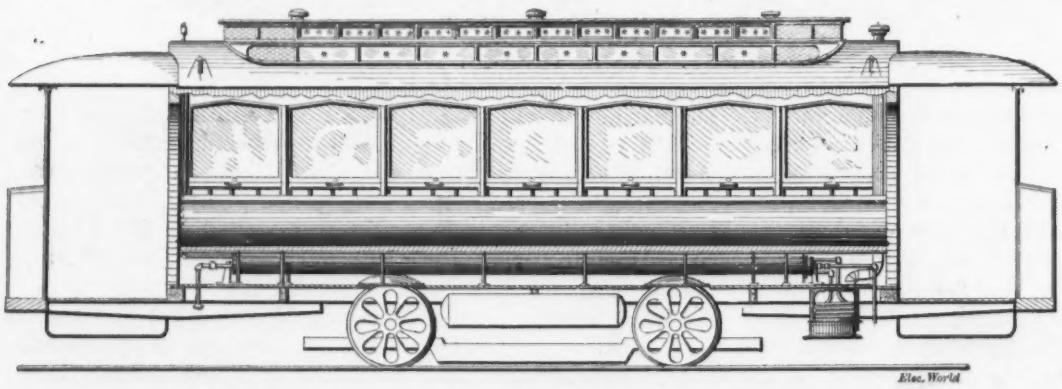
The accompanying illustrations represent the details of a storage heater manufactured by the Gold Car Heating Company, Franklin and Cliff streets, New York, which possesses several features of interest, and whose value has been demonstrated by the best of tests—long practical use.

The storage heater shown is of sufficient length to be placed longitudinally under the seats of a car, and consists of a five-inch boiler tube, enclosing a cylinder four and one-fourth inches in diameter, hermetically sealed at both ends and filled seven-eighths full with a strong solution of non-freezing liquid. When steam is turned on it passes between the outer tube and the interior cylinder, and consequently the warming of the car and the storage of heat commences simultaneously. To obviate the necessity of charging the heater with steam at intervals, a stove enclosing a coil is placed underneath the platform of the car and this enclosed coil is connected with the steam chamber of the heater. When the steam with which the heater has been charged condenses, the condensed water flows into the coil by gravity, in consequence of one end of the storage heater declining toward the stove, and is again made into a steam and returned to the steam chamber of the heater. In this manner the car can be heated for an indefinite period. Should the fire in the stove, through some unforeseen cause, become extinguished, there is at all times sufficient heat retained by the storage heater to keep the car warm from five to seven hours.

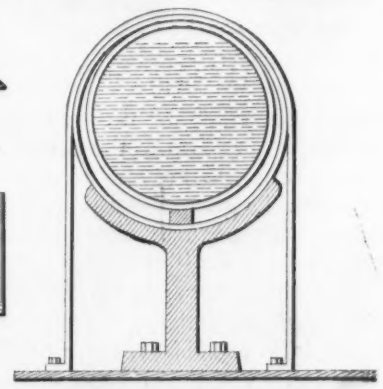
It is a perfectly simple matter to equip any construction of horse, cable or electric cars with these heaters. As they take up no valuable space in the cars, the cost of the apparatus is saved in a very short time by the seating capacity otherwise taken up by a car stove. A pleasant hot water heat is radiated uniformly through the car, and in damp or wet weather the floor is always kept perfectly dry.

All the fittings and parts of the apparatus are of the best quality, and will therefore last as long as the car remains intact. No repairs are needed, and as past achievements are the best promise of the future, the makers cite the fact that over 15,000 of these heaters have been in use on the largest railroads of this country and Europe for from two to ten years, and yet not one of them has required any repairs whatever.

A very thorough test of this system was recently made by the Third Avenue Railroad Company of New York, and for two weeks, during which the thermometer continually registered below 25 degrees, the car in which the Gold heater had been installed was thoroughly heated, to the expressed satisfaction of both the railroad officials and the traveling public, the temperature being maintained at over 70 degrees under every possible condition.



SECTION OF CAR, SHOWING STORAGE HEATER.



SECTION OF HEATER.

In a test made on Saturday, Jan. 13, 1894, on car No. 424 of the Third avenue cable road, running between Fort George and the East River at 125th street, during ten hours

between 1:30 and 11:30 P. M., the temperature inside of the car was continually above 70 degrees, while the temperature outside ranged from 32 to 27 degrees. Thirty-eight pounds steam pressure was on the heater from 12 to 12:45, at which time the fire in the stove was started. The temperature of the car when the steam was turned on was 32 degrees, and when the fire was started the temperature was 65 degrees. The amount of condensation when steam was shut off, at 12:45, was 37 pounds, and when the car was laid up 19 pounds. Thirty-five pounds of coal was used in the stove during the test, but there was sufficient coal in the stove when the trial was completed to last for nearly two more trips, or nearly three hours.

The total condensation during the test was 56 pounds, to produce which, under the conditions existing at the time of the trial, would require the use of seven pounds of coal. This, added to the 35 pounds of coal put in the stove, would amount to 42 pounds and would cost 8 2-5 cents for heating the car for fourteen hours.

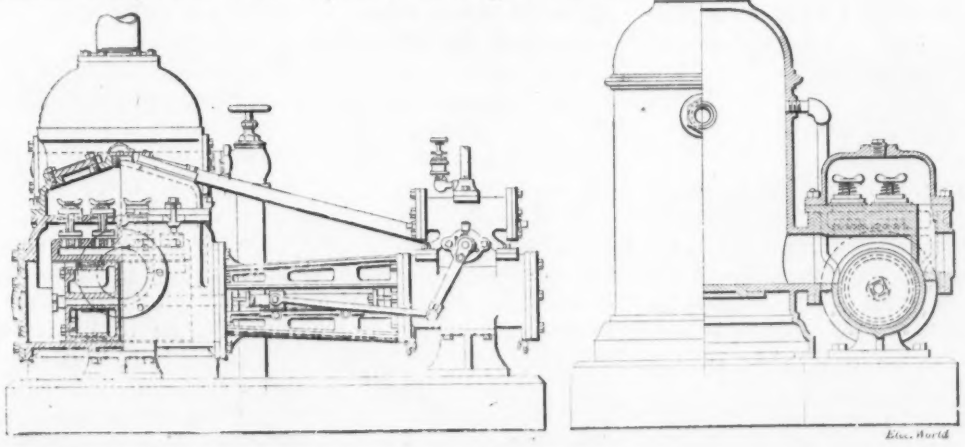
Independent Air Pump and Jet Condenser for Power and Central Stations.

The apparatus illustrated consists of an independent air pump and jet condenser of large capacity. The exhaust steam from the main engines, pumps, etc., is admitted into the top of the condenser and on its descent is met by a fine spray of cold water coming in the opposite direction through a copper spray pipe, thereby producing a complete mechanical mixture of the steam and injection water. The steam is thus condensed, a vacuum formed and the air pump removes the condensed steam and injection water from the condenser, the action being continuous. The condenser is provided with the Davidson "automatic vacuum breaking device," consisting of a copper float and valve opening to the atmosphere. Should the water in the condenser rise above a safe level, the ball float, acting on the valve, secures an immediate connection with the atmosphere, which destroys the vacuum in the condenser and stops the flow of injection water. It is consequently impossible for the water to back up, prime the engine cylinders and cause the serious damage resulting from the use of some forms of condensers.

With a condensing apparatus a considerable saving in fuel or an increase of power can be had at small cost where water is available, and the manufacturer of the apparatus described, M. T. Davidson, 43 Keap street, Brooklyn, guarantees an increase of 25 to 30 per cent. in power through its use. Where additional power is not required, a saving in fuel of 20 to 25 per cent., or a reduction in boiler pressure, which in many cases is desirable, may be obtained. The power required to operate this condenser and air pump is claimed to be not more than 2 or perhaps 2 1-2 per cent. of that of the engines which it serves, against 5 to 7 per cent. in the ordinary condensing apparatus, with its air pump a component part, and this power is not taken from the engine, where it is most expensive, but direct from the boiler. The quantity of injection water required in this latitude will be about 20 to 25 times the amount required for the boiler. The condensing water, after leaving the condenser for the hot well, should have a temperature of about 100, and can be used for boiler feeding. When a closed feed water heater of any pattern is already in use, it need not be laid aside, as it will act as a surface condenser between the engine and the independent condenser, and increase the temperature of the feed water so that it can be returned to the boiler at a temperature of about 150.

A single condenser can be used for two or more engines, for pumps, etc., any or all of which may be stopped without interfering in the least with its action. Being wholly independent of the engine, it can be started to free the cylinder from water and form a vacuum before starting the engine. In its operation it assists in regulating the running of the engine, particularly when the load is variable.

This condenser requires no steam pump (which is necessary with some forms of condensers) to lift its injection water, as it will lift from any point that can be reached by pumps in general use, and requires no attention whatever beyond starting and stopping; once started, and the steam and injection water adjusted, the apparatus is automatic. It can be set up by any mechanic, it being only necessary to select the most convenient place for water connection and lead the exhaust from the engine to the apparatus. In most cases no masonry foundation is required, and but little more floor space than is occupied by a common steam pump. It is noiseless in its operation, and its location in the engine room is entirely unobjectionable. By the use of two-gate valves or a three-way cock the condenser can be shut off at will, leaving the engine simply non-condensing, and by the use of the Davidson automatic exhaust relief valve this change can be made automatically.



INDEPENDENT AIR PUMP AND JET CONDENSER.

New Keyless Socket.

The accompanying cut shows a new style of keyless socket designed especially for street fixtures, brackets, etc., where a socket is required to screw on a pipe through which wires are led to the socket. The nipple is threaded for 3-8 gas pipe, and by reference to the cut it will be seen that there is ample room within the socket for disposing of the leading-in wires. The sockets are made to fit S. M., T. H. and Edison lamps, and are manufactured by the Iona Manufacturing Company, 336 Congress street, Boston, Mass.

KEYLESS SOCKET.

Imperial Dry Battery.

While the Imperial battery we illustrate has been on the market for more than three years, it has only been within the past year, since Mr. Burnley has connected himself with the Miamisburg Electric Company, Miamisburg, Ohio, that they have been manufactured in sufficient quantities to supply the demand. Advantages of this battery are that the depolarizer used does not become a dead weight or resistance, and it is not possible for the battery to deplete itself by used-up depolarizing matter, and, therefore, the possibility of internal short-circuiting is eliminated. It consumes material only when the circuit is closed, and will not, therefore, deteriorate when not doing work; thus giving back in actual service rendered an equivalent for money expended and possessing the superior merit of holding its initial force over long periods of time, enabling dealers to place them on their shelves without an appreciable deterioration. They are slow to polarize and quick to recuperate and not liable to rapid failure, and it is almost impossible to deplete the cell by exhaustive work so that it will not do good service; hence, its efficiency is all that could be desired. They are hermetically sealed and remain so, and will not boil over or burst the seal, and oozing of the salts from the top is entirely eliminated. Its internal resistance is small and possesses a high and quite constant E. M. F. The Imperial is not a closed-circuit battery, and should not be so used, but it is intended for all purposes for which an open circuit battery is used, and is constructed to meet all the conditions required for such a battery by the general trade. Its voltage is 1.5 and amperage from 7 to 10. Where higher amperage is wanted special batteries are made.

IMPERIAL DRY BATTERY.

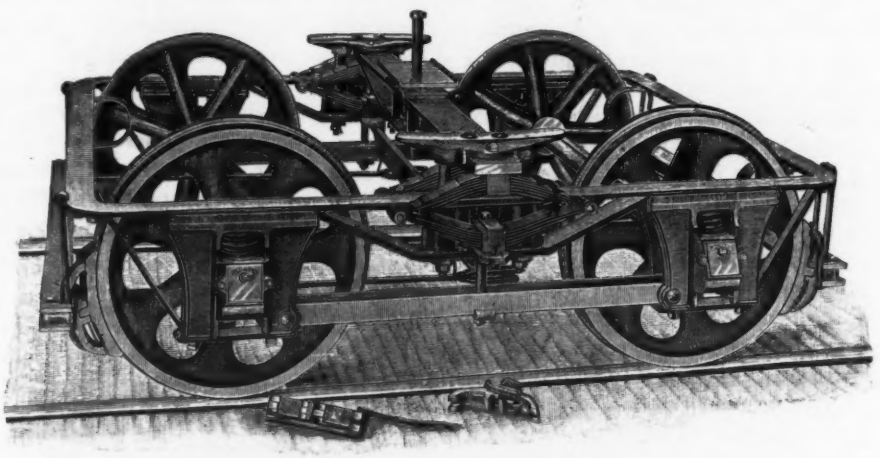
The Empire State Radial Truck.

The truck we illustrate, manufactured by the Taylor Electric Truck Company, Troy, N. Y., is designed on the radial principle; that is, the traction is applied from a point central to the four wheels and not from plates on the side of the frame, and is claimed to be the only radial truck designed for electric motors in which the car body is supported by elliptic springs, and the only one that can be run safely around curves at a high speed.

The sides are composed of two steel bars placed edgewise, firmly bolted together, and secured at each end by trussed end bars, and in the centre by two heavy wrought iron bars placed edgewise, which also afford a place for the attachment of the motor or cable grip. The independent rectangular frame thus made forms a rigid and substantial base for the construction of the truck. To the side bars are firmly bolted the pedestals or jaws that receive the axle boxes, which slide freely between the vertical guides of the pedestal, thus keeping the axles parallel with each other, and resisting the pressure of the brake when applied to the wheels. On each side of the bottom of the pedestal are sockets which receive the adjustable angular braces supporting the ends and centres of the frame. Connecting the two arms of the pedestals is a strong steel stay, fitting tightly between shoulders. Entering the sockets of these stays are adjustable tubular braces, extending from pedestal to pedestal, and with the side bars and angular braces forming a simple, and at the same time a substantial truss, distributing the weight of car and the strains from motor and all other causes over the entire frame of the truck.

Above and resting on the axle boxes, and between the side bars, are half elliptic springs, engaging in yokes at their ends and giving a perfectly free and elastic action, which enables them to receive and reduce the shock and jolting so commonly experienced in electric cars. These springs also reduce the shock and strain on motors caused by obstructions on the rails or irregularities in the road bed. To further secure easy riding, at each end of the truck frame is placed a pair of elliptic springs, securely fastened to the trussed end bar. Upon these springs, but not fastened to them, is placed the body bolster, extending across the car and engaging the side sills by angle irons at each end.

The car body is fastened to the truck by king bolts placed in the centre at each end, and passing through the bolster and end bar. These king bolts are arranged with a coiled spring that bears against the centre of trussed end bar upon the under side, and assists the full elliptic springs in preventing the end teetering of the car body.



IMPROVED RADIAL TRUCK.

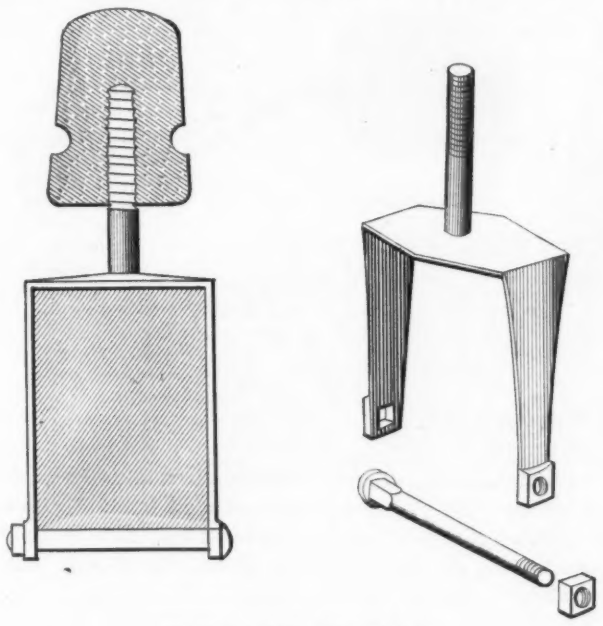
The truck is equipped with a compound lever brake, by which the power is applied centrally, and by which an even and direct pressure of the brake shoes is put upon all the wheels at the same instant, thereby stopping the car gradually and quickly. These brakes are so hung that the shoe adjusts itself to the periphery of the wheel whether the car is light or loaded, thereby securing a uniform wear of the brake shoe. The brake shoe is entirely independent of the brake head, and is held to it by a key, which can be readily removed, allowing the worn-out shoe to be replaced by another, without unscrewing a single bolt, thus saving time and expense. The brakes are also supplied with an adjustable releasing spring, which can be so nicely adjusted that each shoe can be set at an equal distance from the wheels. The brake rods are provided with quick-acting turnbuckles to take up the slack caused by wear, and all adjustments can be made from the sides, without the necessity of running the truck over a pit. When a motor car is used with a trailer, and both cars mounted upon this truck, an additional device can be attached to the brake by which both

cars can be controlled by the motorman, and the services of a brakeman on the trailer dispensed with.

From the above description it will be seen that solidity of construction is assured, and that any width of car frame can be used without change of construction. The durability is great, and little or no wear comes on the car body, and no uneven wear on the journals and bearings. All working parts of the motor are accessible without disturbing any part of the truck, and the truck can be quickly removed from the car body. By the peculiar combination of the elliptic springs there is no end teetering, even when running at a high rate of speed, and an easy and elastic movement is given to the car body, thereby obviating the shocks and unpleasant jolts so commonly experienced in electric cars.

Insulator Support.

The insulator support we illustrate, manufactured by Henley & Laudermilk, Paris, Tenn., obviates the employment of holes in the cross arm of the pole. It can be adjusted to any desired point on the arm and there rigidly clamped in position. It will protect the cross arm from weather cracks, and in a measure avoid inside decay, as the device is entirely external of the arm, and no holes are necessary which would



INSULATOR SUPPORT.

admit water. The employment of the improved support renders the cross arm stronger and more durable, as it does not require to be perforated for the passage of the ordinary insulator pin, and for the same reason the size of the cross arm can be reduced. The support can be quickly and conveniently applied or removed, and where there are more wires on one side of the pole than the other side an efficient balance can be obtained by adjusting the supports on the side carrying the least number of wires furthest from the pole.

A Telephone Exchange System.

An improved telephone switchboard exchange has been placed on the market by the Lockwood Electric Telephone Construction Company, 18 Columbia Heights, Brooklyn, N. Y., which claims unusual simplicity of construction and ease of operation. The main feature of the switchboard is a plug which takes the place of a spring jack, and which has a push button in the back end for the purpose of cutting in a local battery for signal purposes at the magneto bell, if desired. When the plug is placed in the hole in the switchboard by the operator the metallic circuit is completed, and then by pushing the button it calls up both ends of the line. The switchboard and telephone connections are diagrammatically shown in Fig. 1, which also gives a detail of the plug. Each subscriber has a switchboard constructed upon this plan, with as many connections or holes for the plug as there are connections, and by placing the plug in the different holes, and pressing the button at the end he can

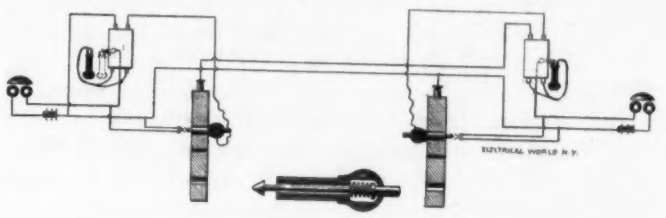


FIG. 1.—TELEPHONE EXCHANGE SYSTEM.

place himself in connection with any of the subscribers he may desire. When not in use the plug is placed in a ground hole.

Mr. William C. Lockwood was among the first in the telephone field, one of his patents on a magnetic transmitter, No. 233,360, bearing date Oct. 19, 1880, and the same year the Lockwood Telephone Company, of Chicago, was started. He has been actively engaged in the telephone field since then, producing a number of improvements, of which one was a practical system of direct-current telephony, patented in March, 1892.

The transmitter shown in Fig. 2 is an improvement on that of the patent of 1880. Its chief feature is an iron ring

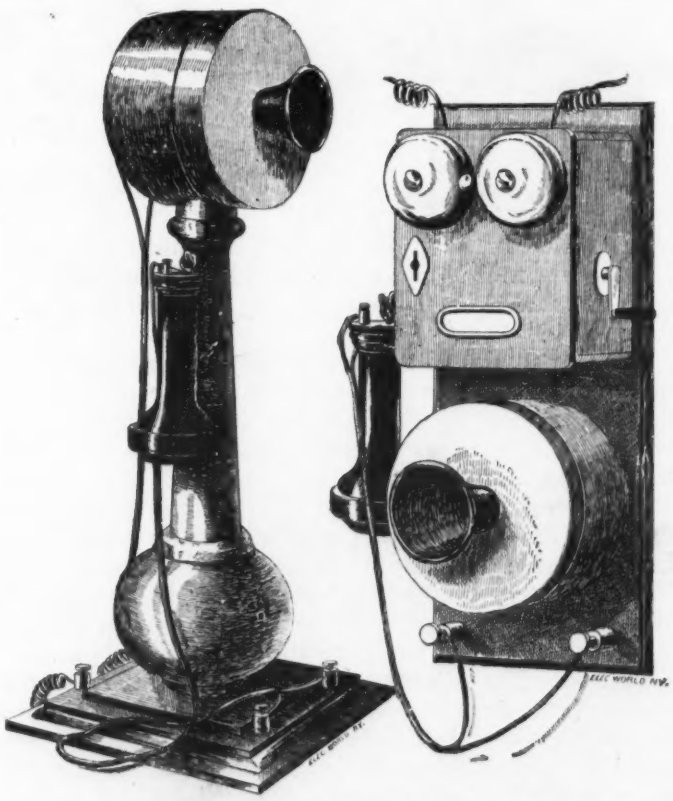


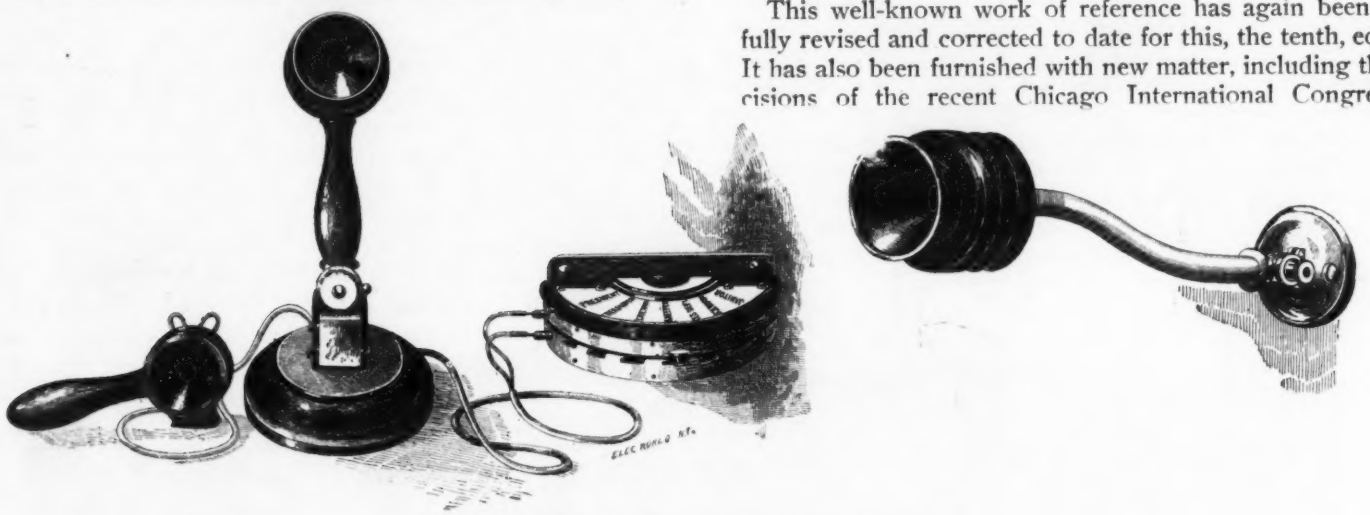
FIG. 2.—TELEPHONE EXCHANGE SYSTEM.

upon which the metal diaphragm rests, this iron ring in turn resting upon a mica ring, and it is claimed that this renders the instrument exceedingly sensitive. The illustration shows two styles, one being a complete set with magneto bells, etc., and the other a desk transmitter and receiver. It is claimed that this transmitter and receiver will work effectively 25 miles, and has been tested for a distance of 170 miles.

An Automatic Telephone Service.

The system of telephonic intercommunication which we illustrate, the invention of Mr. T. McCoubray, P. O. Box 34, New York, and formerly secretary of the National Electric Light Association, is designed for use in warehouses, stores, mills, factories, ships and large plants of every description. It is also especially adapted for use in small centres or villages where a limited number of subscribers would not justify the installation of an expensive exchange or central station and attendant operators.

The auto-service is designed so that when the operator at any one station is in communication with any other, the circuit is kept closed and the hand left free for use in writing, etc. When the hand-phone is restored to its normal position, however, a warning bell will ring continually until the calling key is released, thus opening the circuit and leaving the station ready to be called. In this system it is not necessary to place the hand-phone in any fixed relation to any other part of the apparatus; it is simply laid down anywhere within the limit allowed by the flexible connections, and the station is always in such relation to the outlying stations as to admit calling up or being signalled to by any of them.



AUTOMATIC TELEPHONE SYSTEM.

Another advantage is that when any station signals to any other a bell rings at both stations, and the picking up of the hand-phone by the operator at the outlying station changes the character of the signal at the station calling, thus giving instantaneous notice that the call has been heard and conversation may begin. This "return" ring thus demonstrates that the outlying station is being signalled, and insures the certainty of the circuit being in order. There is but one battery source required, and this is placed in some convenient place, where it may be inspected at any time, should the necessity arise, by the person in whose care it would be. The advantage of this single battery source is apparent, as, for example, where a system of 50 stations is employed, with this system but six cells of battery, all located at one place, would be required. In other systems there would be needed several hundred cells of battery to perform the same service, scattered in various parts of the territory, necessitating great expense and constant care. The signalling box—unlike other systems—has but a single key, which is used to place it in connection with any of the outlying stations. The signal operates only at the selected station, and does not ring up any other, except as desired. In this system there is no necessity of employing both hands—one to hold the telephone to the ear and the other to hold down the key or button; a very grave objection when the user has occasion to make memoranda. Where the necessity of using both hands in other systems does not exist, they involve the closing of a switch or the insertion of a plug; in either case, a neglect, through forgetfulness, to restore the line to its normal condition would render useless the signalling apparatus, which objection does not apply to this system, nor the objection of always hanging the telephone on a hook or placing it in some certain relation to the line to keep it in circuit. The apparatus illustrated is designed for eight stations,but the system may be applied to any number from two to one hundred, or more. Both a stand and a bracket transmitter are shown in the cut.

New Books.

A POCKET BOOK OF ELECTRICAL RULES AND TABLES. For the use of Electricians and Engineers. By John Munro, C. E., and Andrew Jamieson, M. I. C. E., F. R. S. E. Tenth edition, revised and enlarged. London: Charles Griffin & Co. Price, $2.50.

This well-known work of reference has again been carefully revised and corrected to date for this, the tenth, edition. It has also been furnished with new matter, including the decisions of the recent Chicago International Congress of Electricians in regard to nomenclature, but the authors do not include the notation countenanced by the congress, on the ground that it is not as good as their own, and suggest a combination of the two systems—a suggestion which will probably meet with little approval. Among the new matter is an illustrated description of a ballistic galvanometer, with directions how to use it in obtaining magnetic induction, permeability and hysteresis curves, as well as for determining the capacity of a cable or condenser in absolute measure; magnetization tests by the magnetometer method; five different tests on self and mutual induction, four on the measurement of low resistances and one on the efficiency of dynamos by Cardew's method; a description of the internal arrangements of and connections for Evershed's ohmmeter and for the Crompton-Pochin arc lamp, and Lloyd's rules for ship lighting. Several important tables relating to pure copper wire and incandescent lamps have also been added.

Electric Welding of Rails.

About 10 per cent. of the electrically welded rails in Boston have broken in service. The experiment proved that a continuous rail, protected by the pavement, shows no ill effect from expansion; but whether the rails broke from contraction or from inherent weakness due to the welding, is yet to be determined. Hereafter the entire end surfaces, including the head, will be united, and care will be exercised not to injure the fibre of the metal or to restrain the expansion due to the heat.

Financial Intelligence.

The Electrical Stock Market.

NEW YORK, Feb. 17, 1894.

ELECTRICAL STOCKS have been practically featureless this week—so far as any distinct movement in their quotations is noticeable. Neither Western Union nor General Electric has been the factor. One or the other generally is in the New York market, while Boston traders have deserted Westinghouse and Bell telephone for railway shares.

GENERAL ELECTRIC common stock has held its own this week with a firmness that has been very encouraging to interested parties. There is no doubt that many of the more timid bears have been forced to cover, and this is given as a reason for the recent strength. Many shrewd operators still profess to believe that the company's condition is not yet what it should be, and continue to prophesy further declines. They argue that much of the past business has been done at a loss, and that the margin of profit even now is very narrow. There is good reason for believing, too, that many insiders who bought their stock long ago have recently parted and are still letting go of their stock—in fact, to such an extent that the shifting of the control from Boston to the New Yorkers is now understood to be a real fact. If so, a radical change in the management at the coming annual meeting is assured, though there are technical denials in plenty. The Drexel-Morgan-Vanderbilt-Twombly interests now hold control of the stock to such an extent as to practically corner it, and already talk is heard of the election to the presidency next April of Mr. Twombly. Talk is, moreover, heard of scaling down the common stock, so as to wipe off the shrinkages in assets written off on the books of the company for the past six months and assure the return of dividends on both classes of stock, but as there are no immediate prospects of any distribution among stockholders, a director's point that the discussion is premature is well taken. On the other hand, people familiar with the workings of the company say that its finances are in excellent shape again and that with any revival in general trade resumption of dividends may be counted upon. An official statement is promised for March 1, showing that the company has no floating debt and no paper outstanding.

THE ELECTRIC CORPORATION gives notices to subscribers to the capital stock that they must surrender their subscription receipts to the American Loan and Trust Company to enable the directors to carry out their plan of postponing all further calls upon the several subscriptions for stock and of distributing the 7 per cent. debentures to those who have paid 50 per cent. of their subscriptions, the debentures being issued at par value to the amount of the subscription. Pending the issue of new subscription receipts, temporary receipts will be given. The removal of the Electric Corporation from the General Electric offices in Boston to new quarters gave rise to renewed reports of a Lynn syndicate to take the old Thomson-Houston works, but these statements are absolutely denied.

WESTINGHOUSE ELECTRIC common and preferred stocks have maintained the strength imparted to their quotation by the favorable announcements of last week. Pittsburg and Boston advices continue bullish, and great things are expected in the way of profits to the company from Mr. Westinghouse's new third rail system and the other plans in operation for the company's commercial welfare. The company will pay on March 1 interest then due on its scrip.

WESTERN UNION TELEGRAPH has had an appreciable advance in recent days. It is generally attributed to covering shorts for a prominent bear operator. It is thought that interests associated with the management have taken advantage of the covering movement to reduce their holdings. A director admits that the losses from the closing up of the pool rooms has been very great, but there are hopes that the loss of this business will be compensated in some way. The company is exercising all kinds of retrenchment in order to keep earnings up, and the net revenue, as a result of the great retrenchment, will not show up so badly as expected.

THE EDISON ELECTRIC ILLUMINATING COMPANY of New York makes a good showing in its January statement. Gross receipts were $135,184, an increase of $14,953 over January, 1893. Expenses were only $58,340, so that net earnings were $76,843, or $10,643 more than last year. The company reports 195,848 incandescent lamps installed, or 48,977 more than a year ago; 2,649 arc lamps, a gain of 980, and 5,669 h. p. in motors, an increase of 1,777 h. p.

AMERICAN BELL TELEPHONE still furnishes Boston with a deal of gossip. Indications point to the speedy granting of the petition for an increase in the capital stock to $50,000,000. One of the company's lawyers says that, if the request is refused, the company would remove to New York, where assent to the plan would be obtained. Although an inimical spirit to the Bell company has developed in both branches of the Massachusetts Legislature, it is likely that the threatened loss of the great revenue that the State derives from taxation of the corporation will effectually dislodge any and all opposition.

ELECTRICAL STOCKS.

	Par.	Bid.	Asked.
Brush Ill., New York	50	20	35
Detroit Electrical Works	10	2	3
Cleveland General Electric Co	—	85	90
East River Electric Light	100	—	65
Electric Con. & Supply Co., pref	15	15	16
" " " " com	15	15	17½
Edison Electric Ill., New York	100	96	98
" " " " 1sts	—	105¼	105½
Edison Electric Ill., Brooklyn	100	99	102
" " " Boston	100	112	115
" " " Chicago	100	145	150
" " " Philadelphia	100	115	120
Edison Electric Light of Europe	—	—	3
" Bonds	—	80	85
" Ore Milling	—	5	12
Fort Wayne Electric	—	4½	6½
General Electric Company	100	36	36¼
" " " deb. 5's	—	72	74
Interior Conduit and Ins. Co	100	20	30
Mount Morris Electric	—	—	65
Westinghouse Consolidated	50	45	47
" " " pref.	50	26	27
Western Union Telegraph	—	83⅝	83½

New Incorporations.

THE ST. LAWRENCE RIVER POWER COMPANY, Buffalo, N. Y., maximum capital stock $2,500,000. The promoters are C. F. Whitcher, C. C. Conroy, B. Kittinger, J. G. Taylor, all of Buffalo.

THE METROPOLITAN ELECTRIC COMPANY, Reading, Pa., capital stock $10,000, has been formed to supply light, heat and power. The promoters are R. Nelson Buckley, J. A. Rigg and R. B. Jones.

THE EAST SNYDER AVENUE PASSENGER RAILWAY COMPANY, Philadelphia, Pa., has been formed to construct and operate an electric railway. D. C. Golden, H. C. Murphy and J. C. Lugar are interested.

THE NEW YORK ELECTRICAL ENGINEERING COMPANY, New York, capital stock $10,000, has been formed to construct electrical plants. M. M. Jacobs, F. G. Writer, F. D. Kivemore, New York, are the promoters.

THE LAKE STREET MANUFACTURING BLOCK, Chicago, Ill., capital stock $350,000, has been formed to furnish and create light, heat and power for itself and others. D. J. Davis, T. Rankin and J. A. Woodbury are interested.

THE ANTHRACITE ELECTRIC LIGHT, HEAT AND POWER COMPANY, Scranton, Pa., capital stock $25,000, has been formed to supply light, heat and power by electricity. W. S. Mears, A. H. Turner and F. W. Bleckley are interested.

HUNTINGDON STREET CONNECTION PASSENGER RAILWAY COMPANY, Philadelphia, Pa., capital stock $6,000, has been formed to erect and operate an electric railway. G. W. Widener, W. L. Elkins and G. Yarrow are the promoters.

THE LACKAWANNA VALLEY STREET PASSENGER RAILWAY COMPANY, Mayfield, Pa., capital stock $100,000, has been formed to construct and operate an electric railway. The promoters are W. Walker, J. D. Stocker and J. D. Caryl.

THE PLACERVILLE ELECTRIC COMPANY, Auburn, Cal., capital stock $20,000, has been formed to light the streets, residences and business houses of Placerville. R. F. Burns, W. S. Graham and F. P. Tuttle, Auburn, Cal., are interested.

THE CHICAGO ELECTRIC COMPANY, Chicago, Ill., capital stock $1,000,000, has been formed to manufacture electrical apparatus and to supply electricity for various purposes. W. M. Lenhart, J. W. Alderman and E. S. Norton are interested.

THE CHERRY STREET PASSENGER RAILWAY COMPANY, Philadelphia, Pa., capital stock $12,000, has been organized to construct and maintain an electric railway in Philadelphia, Pa. D. C. Golden, H. C. Murphy and J. C. Lugar are the promoters.

THE CALIFORNIA COLONIZATION COMPANY, Los Angeles, Cal., capital stock $100,000, has been formed to build electric light works, waterworks, etc., etc. J. J. Caspar, F. L. Alles, G. W. MacKnight and J. H. Case, all of Los Angeles, are interested.

THE CHICAGO ELECTRIC TRUCK COMPANY, Chicago, Ill., capital stock $25,000, has been formed to manufacture and sell electric motor trucks, wheels and appliances for electric railways. C. W. Lyman, J. Fraser and G. H. Graham are the promoters.

INDEPENDENCE AND RUSH PARK STREET RAILWAY COMPANY, Independence, Iowa, capital stock $25,000, has been formed to operate an electric or steam railway at Independence, Iowa. R. M. Campbell, Z. Stout and A. D. Guernsey, of that town, are the incorporators.

THE SUBURBAN RAILWAY AND ELECTRIC COMPANY, Elizabeth, N. J., capital stock $750,000, has been formed to construct and operate street railways. J. S. Bartlett, C. H. Newhall, Lynn, Mass.; W. B. Hosmer, Boston, Mass., and J. B. McGiffert, Roselle, N. J., are the organizers.

THE ELECTRIC STORAGE AND EQUIPMENT COMPANY, Chicago, Ill., capital stock $250,000, has been formed to manufacture electrodes for storage batteries, rheostats, switches, arc

lights, dynamos, etc., and to equip cars, etc. E. W. Applegate, O. R. Stratton and H. B. Lindley are interested.

THE UNIVERSAL INDEX CLEAT COMPANY, Jersey City, N. J., capital stock $75,000, has been formed to manufacture and sell cleats for holding and carrying electric wires. G. E. Evans, Jersey City, N. J.; J. D. Gould, Boston, Mass., and H. L. Washburn, New York, N. Y., are the incorporators.

THE STERLING SUPPLY AND MANUFACTURING COMPANY, New York City, capital stock $15,000, has been formed to manufacture supplies for electric, cable, horse and steam railways, etc. W. D. Baldwin, W. H. White, Jr., and J. R. Furman, all of 38 Park Row, New York, are interested.

THE MUSKINGUM ELECTRIC COMPANY, Zanesville, Ohio, capital stock $50,000, has been formed to construct and operate electric plants to manufacture and distribute electric currents for light, heat and power. G. L. Foley, T. J. Barton, L. G. England, E. L. Winchell and W. D. Chapman are interested.

THE AUERBACH-WOOLVERTON ELECTRIC COMPANY, Jersey City, N. J., capital stock $1,000,000, has been formed to manufacture and sell under letters patent of the United States electric arc lamps. G. L. Record, Jersey City, N. J.; S. H. Schwarz and J. S. Colland, New York, are the interested parties.

THE MERCHANTS' ELECTRIC LIGHT AND POWER COMPANY, Gainesville, Tex., capital stock $25,000, has been formed to erect and operate electric light, heat and power machinery for generating light, heat and power. C. A. Zuber, San Antonio, and W. H. McGaw and E. J. O'Beirne are the promoters.

THE TAMA AND TOLEDO RAILWAY AND LIGHT COMPANY, Tama, Iowa, capital stock $80,000, has been formed to build and equip an electric railway from Tama to Toledo, Iowa, and also electric light plants. L. H. Ong, W. B. Ong, both of New Sharon, and D. S. Couch, of Colfax, Iowa, are the promoters.

THE ELDORADO LIGHT AND FUEL COMPANY, Eldorado, Kan., capital stock $75,000, has been formed to generate and supply electricity and fuel gas; also to construct electric and gas plants, street railway lines, etc. R. Hatfield, O. H. Beattey, H. Burnett, W. G. Thomas, and R. E. Lawrence, all of Wichita, are interested.

WADDINGTON, N. Y.—The Erie Construction Company, $100,000, has been incorporated to develop the water power in the vicinity of Waddington. The officers are Chas. C. Conroy, president; Chas. F. Whitcher, secretary, and Wm. Hemming, treasurer. They propose to develop power for electricity to supply to factories.

THE BAKER ENGINEERING COMPANY, Seattle, Wash., capital stock $25,000, has been formed to construct and equip steam railroads, telephones, electric lines, waterworks, etc., and to engage in the manufacture of electric and steam machinery. F. H. Coe, A. M. Brookes, C. H. Baker and John Fairfield are the promoters.

THE STANDARD ELECTRIC EQUIPMENT COMPANY, Jersey City, N. J., capital stock $25,000, has been formed to manufacture and sell electric light, power, railway and allied equipment, and to construct and equip electrical plants of every description. J. F. O'Day, J. O'Day, New York, and L. H. Schenck, Neshantic, N. J., are the incorporators.

THE R. HAAS ELECTRIC AND MANUFACTURING COMPANY, 406 South Sixth street, Springfield, Ill., has been incorporated with a capital stock of $10,000, the object being to manufacture electric appliances, devices and general electric business. The incorporator are Rudolph Haas, Edward C. Haas and William L. Blucke.

THE McEVOY ELECTRIC CONSTRUCTION AND SUPPLY COMPANY, Jersey City, N. J., capital stock $250,000, has been formed to construct all kinds of electrical appliances. E. J. McEvoy, J. B. A. McEvoy, 318 East 37th street; E. C. O'Brien, 167 East 78th street; E. J. Kenney, Thomas Kenney, 227 East 35th street, New York City, and J. B. Young are the incorporators.

THE SPANISH AND SOUTH AMERICAN LOVE ELECTRICAL TRACTION COMPANY, Jersey City, N. J., capital stock $100,000, has been formed to hold, sell, etc., patent rights and letters patent for inventions, processes and apparatus used in producing light, heat and power by electricity. H. Stanton, De Forest Manice, New York, and A. I. Drayton, Jersey City, N. J., are interested.

Special Correspondence.

New York Notes.

OFFICE OF THE ELECTRICAL WORLD,
41 Park Row, NEW YORK, Feb. 17, 1894.

MR. FRANK S. DE RONDE, general sales agent for the Standard Paint Company, 2 Liberty street, New York, reports that the Metropolitan Electric Company, Chicago, Ill., who some three weeks ago secured the Western agency for the sale of P. & B. compound and other products of the Standard Paint Company, at which time they ordered a large bill of goods, have met with such flattering success that they have duplicated their original order.

THE HINE & ROBERTSON COMPANY, 106 Liberty street, New York, announces that on account of the rapidly increasing magnitude of its indicator business it has become necessary to make a separate department of it, which is in charge of A. C. Lippincott.

New England Notes.

BRANCH OFFICE OF THE ELECTRICAL WORLD,
Room 91, Hathaway Building, 620 Atlantic Ave.,
BOSTON, Mass., Feb. 17, 1894.

MARBLEHEAD, MASS.—At the annual town meeting on March 1 an article in the warrant will call for action on the project to purchase an electric light plant.

THE WEST END STREET RAILWAY suburban passengers were better served in and about Boston and with less delay in transportation during the recent storm than those of the steam railroads covering the same sections. The service was exceptionally good on the West End road, and the Boston public duly appreciated it.

PROF. W. L. PUFFER, of the Massachusetts Institute of Technology, Boston, in a lecture on telephone receivers delivered at the Wells Memorial Institute Feb. 13 before a large and appreciative audience, we are informed by the National Telephone Manufacturing Company, stated that as a result of his experiments, comparing the different styles and makes of instruments, the receiver telephone of the National Telephone Manufacturing Company, as shown, was the strongest and most powerful instrument. He especially remarked that the two Bell receiver telephones, as shown, were good instruments, but that the National must be rated as first. Many receiver telephones, both foreign and domestic, were exhibited.

Western Notes.

BRANCH OFFICE OF THE ELECTRICAL WORLD
936 Monadnock Building, CHICAGO, Feb. 16 1894.

THE ST. PAUL ELECTRIC SUPPLY COMPANY has opened a store at 315 Minnesota street, St. Paul, Minn., for the sale of motors, dynamos, electric fans and other electrical supplies. A special feature of the business will be the storage, subject to sale or exchange, of old motors.

THE INDEPENDENT ELECTRIC COMPANY, of 39th street and Stewart avenue, Chicago, well known as manufacturers of fuse wire and mining machinery, have added a new department to their business, and are now prepared to furnish promptly a high quality of slate for all purposes, but with special reference to the requirements of electrical work. They cut to any size, and furnish plain and finished slate in any desired manner or quality.

FROM THE WEST TO THE CONVENTION.—Western delegates to the Electric Light Convention, which meets in Washington Feb. 27, will arrive in the capital Monday, Feb. 26, at 2:10 P. M., over the Chesapeake and Ohio Railway. The trip has been admirably arranged. The delegates from Chicago and the Northwest will leave Chicago via the Big Four route at 8:30 A. M., Feb. 25, and at Indianapolis will be joined by the St. Louis, Kansas City and Peoria contingent; at Cincinnati they will be met by the Queen City electricians and take the famous F. F. V. limited through the most picturesque route in the East to the capital. The train will be solid vestibuled electric lighted and carry a hotel dining car through.

OREGON CITY, Feb. 12, 1894.

IT IS REPORTED that the Point Defiance, Tacoma and Edison Railway Company, of Tacoma, Wash., has issued to the Northwest General Electric Company a mortgage to secure an indebtedness of $96,000.

OREGON CITY will make a test case of Motorman Fields, of the East Railway Company, who was recently arrested by the chief of police for operating an electric freight car on the streets contrary to the provisions of the new city ordinance, imposing a license upon street-car freight business.

THE TACOMA RAILWAY AND MOTOR COMPANY, of Tacoma, Wash., has reduced the monthly pay of its conductors and motormen from $70 to $60. The reduction in salaries is to be in force for three months only, and the men will be paid up to date. The hours of work will probably be shortened somewhat.

PORTLAND, ME.—Mr. C. B. Dalton, of Portland, has two large water powers within 18 and 22 miles, respectively, of Portland, which gives him the whole flow of the Saco River. The power of one is estimated at 5,000 h. p., and the other 2,500 h. p. They are the only two water powers near Portland not in use.

Canadian Notes.

OTTAWA, Feb. 16, 1894.

ST. STEPHEN, N. B.—It is probable that a definite understanding in regard to the electric road will soon be reached and that the road will be built the coming summer.

TORONTO.—The street railway company has called upon local manufacturers for tenders for machinery for a new power house to the extent of 6,000 h. p. They propose constructing also 100 new cars. The total estimated expenditure on improvements will reach close on a million.

GALT AND PRESTON STREET RAILWAY.—The profiles of the Galt and Preston Street Railway are out. The entire length, from the Grand Trunk Railway station (G. W. R.), Galt, to the Del Monte Hotel, in Preston, is 4 73-100 miles. The company has purchased from the tie supplier of the C. P. R. the 10,000 ties required.

OTTAWA, ONT.—An offer has been received from the Fort Wayne Electric Company to install an electric light plant capable of supplying 500 lamps at $70,000. Alderman Cluff also received a letter from the Siemens & Halske Electric Company, of Chicago. Their offer for the same supply was much higher, from $125,000 to $150,000.

NIAGARA FALLS ELECTRIC RAILWAY BRIDGE COMPANY.—Application is made to the Dominion Parliament by the Niagara Falls Electric Railway Bridge Company for power to build a bridge across the Niagara River at some point between Niagara Falls and the Whirlpool Rapids, and to operate thereon an electric railway system, with power to connect with the electric railways on both sides of the river.

A NOVEL APPLICATION for a charter is now before the Canadian government from Gillies & McEchen, of Sydney, Cape Breton, who, on behalf of their clients, are applying for the incorporation of a company under the name of the "Boynton Bicycle Electric Railway Company, of Canada," to construct and operate a bicycle electric railway from the city of Winnipeg, Manitoba, to the Port of Louisburg, in the county of Cape Breton, Nova Scotia, and between any places within the said points, with power to acquire and use water powers and to make contracts for the supply of electrical power for the operation of said railway.

TORONTO.—The Toronto Aqueduct Company is applying for a charter to construct and operate a ship canal and power aqueduct between Lake Ontario and Georgian Bay, through the counties of York and Simcoe and adjoining counties. The company will also seek power to use the waters of Georgian Bay, Lake Simcoe, Holland River and other sources of supply for the purpose of feeding the said canal and the generation or development of electric energy to be used for the production of heat, light or power. The applicants also ask for legislation ratifying any agreement that may be entered into with the city of Toronto, county of York, the townships of York, Etobicoke and Scarborough, the towns of Toronto Junction and North Toronto, the villages of Weston and East Toronto, for a supply of electric heat, light and power.

TORONTO.—President McKenzie, of the Electric Street Railway Company, in his annual report just submitted to the shareholders, says: "While the net earnings of the company have been satisfactory, as yet no dividend has been declared on the stock, although it will be seen by the balance sheet there is a considerable amount of cash in hand after paying all charges. The increased earnings which are expected will demand an increase in the number of cars and an extension of the shops, power and plant; the change of system has not yet been completed, and it is impossible at present to state with precision what amount of money will be required. The directors have entered into an agreement with the Toronto and Mimico Electric Railway and Light Company, Limited, for the acquisition of its privileges, and a ratification of this will be asked at a special meeting of the shareholders, to be specially called for the purpose.

English Notes.

(From Our Own Correspondent.)

LONDON, Feb. 7, 1894.

ELECTRIC LIGHT MAIN ACCIDENTS.—It is satisfactory to note in connection with recent electric light main explosions, both at Newcastle and Scarborough, a Roots' blower is employed to force warmed and dried air into the electric light ducts. The recent slaughtering of a horse at Bournemouth was due, I am told, to the fact that the company has omitted to connect the iron pipes on either side of the brick manholes metallically together, as was suggested by the contractors; the result being that on the main making earth on one side of the manhole, the current on coming to the brickwork had to find its way to the iron pipe on the other side through the surrounding earth.

THE BLACKPOOL ELECTRIC TRAMWAY.—It is only a little more than a year since the Blackpool corporation took over the working of the Blackpool Electric Tramway, and a few weeks ago the papers announced the line was being worked by horses, and that Mr. Thomas Parker, of the Electric Construction Company, and Mr. Holroyd Smith, the designer of the line, had been called in to report upon its condition. The reports of these gentlemen are naturally somewhat optimistic, but the report of Mr. J. Hesketh, the borough electrical engineer, is a striking commentary upon the careful nursing which an electric tramway on the open-conduit system requires, if it is to work with any degree of regularity. It must, however, be remembered, as has been pointed out both by Mr. Parker and Mr. H. Smith, that owing to its proximity to a sandy seashore, the Blackpool line is exposed to conditions which would try even the best possible system of electric traction severely. Mr. Hesketh, after reporting upon the condition of the engines, boilers, belting, dynamos, etc., at the power house, goes on to state with regard to the car motors that the field magnet windings have had to be renewed in some cases, and repaired in almost all, the wires having been ripped bodily off the framework of the motor by the collector's end rising and catching in the coils. He also complains of the impossibility of frequently and thoroughly examining and cleaning the insulators inside the conduit, and states that the leakage during the first few hours of the day is sometimes sufficient to drive 10 or 20 cars. Mr. Hesketh also says that during the past year as many as 24 or 30 collectors have at times been sent into the shed for repairs in one day. "It is my firm conviction," said Mr. Hesketh, in conclusion, "that if the channel construction had originally been such as to admit of a wider slot with more perfect insulators and collectors, the trouble we are now experiencing would never have occurred."

THE BOARD OF TRADE ELECTRIC TRACTION REGULATIONS.—An important conference took place to-day between representatives of the electric traction interest and the leading Board of Trade officials with regard to the draft regulations published by the Board of Trade a short time ago. Each regulation was discussed seriatim, the Board of Trade officials expressing their readiness to make every reasonable concession to the needs of electric traction and gave practical evidence of their intention to do so by promising to favorably consider the majority of the amendments suggested. The main difference between the electric traction people and the Board of Trade is, however, regulation 14, which reads: "In the disposition, connections and working of feeders, the company shall avoid injurious interference with any existing wires," and around this regulation the real fight will centre. At the preliminary conference of to-day the point upon which the electric traction people concentrated their attention was the regulation providing for the interposition of a non-conducting screen between the earth return and any pipe which is within six feet of it. The regulation laying down that the separate lengths of a metal conduit shall be joined, so as to secure metallic continuity, was also objected to, but a reminder from a Board of Trade official of the recent mishap at Bournemouth, which arose from the omission of this very precaution, silenced the objectors. The regulations fixing the maximum leakage for any sized system at 10 amperes and the minimum insulation resistance of all lines insulated returns and feeders laid under ground, at 10 megohms per mile, and the maximum leakage current at 1-100 of an ampere per mile of tramway, were also discussed, and it was stated that these had been made specially stringent, with a view of provoking discussion.

News of the Week.

Electric Light and Power.

RENOVO, PA.—Residents are agitating for electric lights.

EVANS, COL.—Evans is agitating the establishment of an electric lighting plant.

HAMILTON, ONT.—There is a strong sentiment in favor of a municipal plant.

KEWANEE, ILL.—The gas company will apply for a franchise to put in electric lights.

DENISON, IOWA.—The authorities of Denison are negotiating for an electric lighting plant.

ROCKVILLE, CONN.—There is grave dissatisfaction over the electric lighting street service.

KEOKUK, IOWA.—J. C. Hubinger is seeking a franchise for a gas plant, water works and electric light.

RALEIGH, N. C.—The Raleigh "Chronicle" states that the electric lighting service is most unsatisfactory.

BRUNSWICK, IND.—The city of Brunswick recently voted $10,000 in bonds for water works and electric light.

MARENGO, ILL.—The city will put in electric lights and water works as a result of the recent decision of Judge Belvidere.

ASTORIA, ILL.—C. E. Brockman and Alexander Baily, of Mount Sterling, propose to establish an electric light plant in Astoria.

IRVINGTON, IND.—General Cottman is at the head of the movement which is petitioning Council to put in an electric light plant.

DALLAS, TEX.—Sealed proposals will be received to March 1 for building an electric light plant. Geo. W. Crutcher is city secretary.

VICTORIA, TEX.—The Victoria Light, Power and Ice Company will increase its plant, and is in the market for a 1,000-light 1,000-volt alternator.

BUCHANAN, MICH.—The electric light plant will be enlarged, the demand for arc lights being in excess of the original estimate.

ELIZABETHTOWN, KY.—The Council offers for sale the franchise for putting in an electric light and water plant. Address R. L. Wintersmith.

ST. PAUL, MINN.—The mayor and county commissioners are a committee to investigate the cost of a proposed electric light plant for the court house.

LOGANSPORT, IND.—The Council Committee in the matter of electric lights is unanimously in favor of a municipal plant, and will so report to Council.

BAY CITY, MICH.—The committee of the County Board of Supervisors has recommended the purchase of an electrical apparatus for the county house.

EVANSVILLE, Ind.—An ordinance has been introduced in Council authorizing the Department of Public Works to advertise for an electric lighting plant.

CINCINNATI, OHIO.—The Council has appropriated $5,000 for the electric equipment of Eighth street viaduct for railway operation and electric lighting.

STE. GENEVIEVE, MO.—Citizens have organized a stock company to establish a brewery and electric light plant. F. L. Jokerst and E. A. Rosier are interested.

CLEVELAND, OHIO.—Architects Lehman and Schmidt have made plans for a new armory for the O. N. G., to cost $185,000, and to include an electric lighting plant.

TOLEDO, OHIO.—Commissioner Englehard states that the new court house will have a complete electric lighting plant. The jail and armory will be lighted from it.

BUFFALO, N. Y.—The City Council has decided to expend $100,000 to establish an experimental station for municipal electric lighting, likely at Black Rock or East Buffalo.

MARTIN'S FERRY, OHIO.—The City Council has rejected a resolution to call for a vote of citizens in the matter of issuing $30,000 in bonds for an electric lighting plant.

MARIETTA, LANCASTER COUNTY, PA.—The Marietta Electric Company has bought land as site for its plant. It is now soliciting subscriptions to its capital stock of $15,000.

READING, PA.—The directors of the Reading Electric Light and Power Company have voted to lease its works to the Metropolitan Electric Company, chartered Feb. 8 for 99 years.

SPRINGFIELD, ILL.—The Council has adopted a resolution authorizing a committee to devise ways and means for purchasing and constructing a municipal electric lighting plant.

HAMILTON, OHIO.—The Council of Hamilton has accepted the plans and specifications of Engineer Cornell for the proposed electric light plant, and will receive bids for the same.

HILLSDALE, MICH.—The Council has instructed the lighting committee to negotiate for a large dynamo. This refers to a machine for street lighting, and not the dynamos recently purchased.

BORDENTOWN, N. J.—Estimates for an electric lighting plant have been received by Council of Bordentown, but the Council has decided that it is not now in financial shape to take action.

PARSONS, PA.—Secretary Breckley, of the Anthracite Electric Light Company of Scranton, Pa., has offered to put in an electric light plant for Parsons if a five-year contract is given by the borough.

SWANTON, PA.—A meeting of residents of Swanton will be held on the 15th inst. to hear the report of the electric light committee and see if the village will vote to authorize the purchase of another dynamo.

TOPEKA, KAN.—The matter of repairing the electric light plant was referred to the committee on public buildings, with power to act. The engineer has prepared estimates for the repairs, and the clerk will advertise for bids.

FLATBUSH, L. I., N. Y.—Plans are being made by the Knickerbocker Electric Light and Power Company for the erection of a power house on the property of the Flatbush Gas Company, East Broadway and Flatbush avenue.

DOVER, N. H.—There is grave complaint in Dover over the quality of light furnished by the Consolidated Light and Power Company, and unless an immediate improvement is made, some other company will be granted a franchise.

GRIFFIN, GA.—The committee on lights has been authorized to offer a lump sum for the plant of the Thomson-Houston Company now in operation and lighting the city of Griffin, as the city proposes to operate the plant hereafter.

MOMENCE, ILL.—Ex-Mayor Jas. Kerby and B. F. Gray, representing the Momence Electric Light Company, have asked Council to extend their charter for fifteen years. If granted they will reorganize with $10,000 capital and improve the plant.

RICHMOND, VA.—At a meeting of Council Committee on Light the resolution of Mr. Davis was adopted, recommending that the Council consider favorably the Epps resolution, providing for an appropriation of $75,000 for an electric light plant for the city.

IRVINGTON, N. J.—At meeting of Clinton Township Committee, held at Town Hall, Irvington, a petition from property owners in Hilton was received asking the committee to extend the electric light on Springfield avenue as far as South Orange.

KINGSTON, PA.—The West Side Electric Company, which has a plant at Luzerne, Pa., and which is principally owned by John C. Haddock, is applying for a franchise to serve the residents with electric street lighting. The borough council has not yet taken action on the application.

WYOMING, PA.—A motion has been carried that the street lighting committee interview the borough attorney and ascertain if sufficient time yet remains before election on the 20th to vote for or against electric lights for the borough, and for power to levy a tax to defray the cost thereof.

FLATBUSH, L. I., N. Y.—The Town Board of Flatbush has awarded to the Knickerbocker Electric Light Company the contract to light Oaklands, Windsor Terrace and Parkville. The village of Flatbush will be lighted by gas until the present contract with the Flatbush Gas Company expires.

WASECA, MINN.—Sealed proposals will be received to Feb. 20 for furnishing a compound electric light engine and connections. Plans and specifications may be seen at office of city clerk of Waseca, or Chas. T. Loweth, 94 East Fourth street, St. Paul, Minn. Dr. D. S. Cummings is mayor.

ANNAPOLIS, MD.—The City Council has directed the special committee on city lighting to advertise by Feb. 26 for bids according to the plans and specifications of John O. Jodge. The plans call for arc and incandescent systems in one bid, and for arc and incandescent systems in separate bids.

YORK, PA.—The loan bill just recommended to the ways and means and finance committee did not contain a provision for the proposed electric lighting plant for the public buildings, as originally intended, it being the general impression that it would be better to defer this and add to estimate for paving.

IPAVA, ILL.—The Ipava Woolen Mills will, in addition to their present plant, build another, and run lines to the following towns: Lewiston (12 miles), Astoria (12 miles), Tabletown (6 miles), and Vermont (8 miles). It has the franchises for the above towns for fifteen years, and fifteen months to complete the plant.

YORK, PA.—Sealed proposals will be received to March 3, at noon, by the lighting committee of the City Council for lighting the streets of the city of York, for one or five years, with arc electric lights as now lighted. Bidders will specify the system of lighting to be used. T. B. Loucks is secretary of the light committee.

UNION HILL, N. J.—The Hudson Electric Light Company has sent a communication to the Board of Council of Union Hill, stating that it hears that there is desire on the part of residents to change the lighting system from the incandescent to the arc light, and it asks to be advised. The matter was referred to a committee.

MEADVILLE, PA.—City Electrician Geo. M. Hoag has reported unfavorably on the present condition of the electric lighting plant, and repairs will have to be made. It is likely that the city will compel the company which furnished the plant to make repairs, failing which they will have same done by contract and charge to the company.

EAST ORANGE, N. J.—The East Orange Township Committee has decided to readvertise for bids for lighting the township with electricity. According to the bid of the People's Light and Power Company, the lowest bidder, the cost would have been $7,000 less than the gas lighting at present in use, but many of the principal streets would not have been lighted.

CONCORD, N. H.—Custodian Robinson, of the Post Office, has been authorized by the Treasury Department to wire the building for electric lighting, and he invites proposals for the work, which he will immediately forward to the Secretary of the Treasury for consideration. The Department reserves the right to reject any or all bids received, and to defer acceptance to July 1 next.

MONTCLAIR, N. J.—At a meeting of the Township Committee F. S. Woodward applied for a franchise to furnish electric lighting to private consumers, to be a 600-light, 16-candle power plant, and to be in operation within the year. He will not state who is behind the application, and for the present he will not offer to furnish street lights, but may do so later. The matter was deferred for future consideration.

ETNA, PA.—In the matter of the proposed electric plant for Etna, the fourth set of plans has been received by the Council. They were made by Edeburn & Cooper, of Pittsburgh, and the estimated cost is $22,000. The matter was placed in the hands of the finance committee with instructions to get estimates from contractors on building, and bids will then be received for the machinery and apparatus as soon as needed.

OTTAWA, ONT.—The local authorities of Ottawa have decided to ask for power to purchase and operate an electric light plant. Alderman Morris has filed estimates for a plant at $135,000, and the matter will be voted on at special election. It was also decided to call for tenders for an arc light plant of 500 lamps, and to ask the Ottawa Light Company to state the terms upon which they would carry on the lighting for an extended term of five years.

MERIDIAN, MISS., is in complete darkness except for a few gas lamps. Where two months ago it had two electric lighting plants, it now has none. One company, known as the Edison Lighting Company, became financially involved in January, and its apparatus was sold out by the sheriff, thus cutting off 100 arc lights used in lighting the city. The other company—the gas company—lost all its electric apparatus by fire on Feb. 4, cutting off 25 city arc lights. The latter company will shortly rebuild to carry out the entire city lighting.

The Electric Railway.

BRIGANTINE, N. J.—The electric railway at Brigantine Beach will be rebuilt on a trestle, to be beyond the reach of the tide.

SIOUX CITY, IOWA.—The Sioux City cable railway has been granted permission to equip with electric power.

FREELAND, PA.—A contract for the construction of the Freeland branch of the electric railway will be awarded in a few days.

READING, PA.—An ordinance has been introduced granting right of way to the Pottstown, Reading and Boyertown Electric Railway Company.

NEW HAVEN, CONN.—The Fairhaven and Westville Horse Railroad Company asks for leave to extend its lines and to equip with electricity.

WOODBURY, N. J.—The Council has passed an ordinance granting right of way to the Camden, Gloucester and Woodbury Electric Railway Company.

BRIDGEWATER, VA.—Surveyors are going over the road between here and Harrisonburg, and it is likely that an electric line will, ere long, be built.

ROXBOROUGH, PA.—The Roxborough Railway Company in its annual report states that its road will adopt the trolley system during the coming season.

RIDGWAY, ONT.—Capitalists have offered to build an electric line from Ridgway to Crystal Beach for a bonus of $2,000. No names have yet been made public.

HARRISBURG, PA.—As soon as the weather permits, President Denny states that the East Harrisburg Railway Company will begin many important improvements.

NEWARK, N. J.—The Consolidated Traction Company has applied to the Essex County Road Board for permission to extend its road to Millburn, and thence to Short Hills.

MARION, OHIO.—Sealed proposals will be received to March 19 for the construction of a street railway and operation thereof over routes one and two. James Williams is city clerk.

SPRING CITY, PA.—After rejecting the ordinance granted by the Borough Council, the Phoenixville Electric Railway Company has decided to accept it, and work will soon be begun.

HAGERSTOWN, MD.—O. H. Ormsby and S. Ritter Ikes, of the Cumberland Valley Railroad Company, have accepted the franchise offered by the authorities of Hagerstown for a street railway.

GLOUCESTER, MASS.—The directors of the Gloucester Street Railway Company have decided to begin the construction of the branch to Rockport as soon as the weather permits, about 5½ miles.

NEWBURGH, N. Y.—The Newburgh street railway line has been sold to a syndicate headed by Benjamin Norton, of the Atlantic avenue line of Brooklyn, and it will be converted into an electric line.

WASHINGTON, D. C.—The Commissioners of the District have received for report House Bill 557, "To incorporate the Boundary and National Park Elevated Railroad Company in the District of Columbia."

AUSTIN, ILL.—The Town Board of Cicero has passed an ordinance giving to the Lake Street Electric Railway Company the right to build an elevated road in streets and boulevards of Oak Park, Austin and Ridgeland.

HARTFORD, CONN.—The directors of the proposed Hartford and Manchester Tramway Company will take action in the matter of their proposed road to connect with the Hartford street railway line, now extending to Burnside.

MEDINA, N. Y.—A public meeting has been called for Feb. 16 to take action in the propósed electric railway of Captain Lina Beecher from Batavia to the lake, by way of Medina. It is estimated that the road would cost $600,000.

NEW CASTLE, DEL.—A special to the Wilmington "News" states that the proposed electric road from Newcastle to Wilmington is now a certainty; that the corporators have agreed upon a plan of action, and that work will be begun in the spring.

HOLYOKE, MASS.—The People's Electric Street Railway Company will soon apply for a franchise. Wm. F. Whiting, Chas. H. Curran, T. H. Sears, Rollo F. Kelton, Clark O. Carpenter, all of Holyoke are interested. It is proposed to build a 9½-mile road.

LANCASTER, PA.—The Pennsylvania Traction Company has acquired control of the Lancaster Traction Company, of the Columbia and Donegal road and several others in pursuance of its project to build an electric line from Philadelphia to Harrisburg.

WATERTOWN, MASS.—As soon as frost is out of the ground the Newtonville and Watertown Street Railway Company will extend its tracks to the Boston line. The West End Street Railway Company will also build to the Watertown line this spring.

DAVENPORT, IOWA.—Electrical Engineer Fredericks, of the Davenport and Rock Island Railway Company, is completing plans for the electrical equipment of the bridge line. It will be about May when the company will substitute electricity for horse power.

LAWRENCE, MASS.—The South Side Street Railway, to connect Lawrence and Lowell, came before the Board of Selectmen with an application for a franchise, and the matter was taken under deliberation. Larkin T. Trull, of Lowell, Mass., is leader in the movement.

GARDNER, MASS.—The Gardner Street Railway Company has petitioned the Selectmen for leave to build and operate an electric railway in the streets of Gardner. If permission is granted it is the intention of the company to proceed with the work as soon as the frost is out of the ground.

CORNING, N. Y.—F. D. Kingsbury, of Corning, has bought the franchise for a street railway, which was offered to a company last year and rejected. He proposes to build a street railway in Corning, and will form a company for that purpose. There is promise of strong local support.

BOSTON, MASS.—Two applications were made for charters for elevated roads in Boston and vicinity on Feb. 7. John W. Ayers asks for incorporation of the Metropolitan Elevated Railway Company, $5,000,000, and Reynolds T. White also asks for authority to build and operate an elevated road.

BOONSBORO, MD.—The Boonsboro "Times" states that as soon as the matter of building the proposed electric road can be gotten out of the hands of the contractors, a new contract will be let and the road, which Hughes & Rigby wanted $103,500 to build, will be built for one-half that amount by local workmen.

WATERBURY AND STOWE, IOWA, are to be connected by an electric freight and passenger railway ten miles long, to be run from water power, at an estimated cost of $150,000, of which Stowe has already voted $40,000. The company is named the Mount Mansfield Electric Railway Company, and E. D. Blackwell, of Montpelier, is president.

LOCKHAVEN, PA.—E. B. Carr, of Jersey City, N. J., is in Lockhaven, Pa., and is agitating for the building of an electric railway from Lockhaven to Mill Hall. He is interested in a firm of contractors which builds trolley railways. He is conferring with the gentlemen who were recently granted a franchise to build a street railway, and is offering them liberal terms.

SPRINGFIELD, MASS.—Preliminary steps have been taken to incorporate the Wyman-Lea Street Railway Company, $300,000, to connect Holyoke, Willimasett, Chicopee Falls and Springfield. Amongst those interested are W. B. C. Pearsons, of Holyoke; George S. Taylor, of Chicopee; George Nye, of Springfield; Henry S. Dickinson, of Springfield; Horatio Gore, of Boston, and B. W. Woodward, of Cambridge.

MIDDLETOWN, CONN.—It is now stated that the proposed electric road between Middletown and Meriden will be built and in running order by July 1. The Middletown Company will spend $150,000 on this extension this spring. The company is in the hands of a syndicate represented by ex-Governor Waller and Attorney S. H. Wagner, of New Haven. A large power house will have to be built in Middletown.

ST. LOUIS, MO.—At a meeting of the stockholders of the Fourth Street and Arsenal Railway Company it was voted to issue $150,000 gold bonds, payable to the Union Trust Company, of St. Louis, at 6 per cent interest. Contracts will immediately be let for the building of this road. Chas. Green is president of the company, and he is preparing an ordinance granting permission to run north to Baden and south to Carondelet.

TEWKSBURY, MASS.—The hearing of the petition of Larkin T. Trull, Jos. L. Chalifoux, Wm. S. Knox, N. E. Clemons and Winslow, representing the South Side Street Railway Company, for right to build, equip and operate an electric street railway in Tewksbury, will be heard at public hearing in town hall on Feb. 21 at 2 P. M. F. H. Farmer, George E. Marshall and Frank A. Fitzgerald are selectmen of Tewksbury.

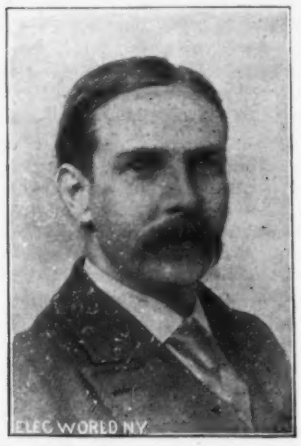
LEWISTON, NIAGARA COUNTY, N. Y.—The Lewiston and Youngstown Electric Railway has again come to the front with an offer to build a line to Fifth, Centre and other streets, but there is strong opposition to the Fifth and Centre street route from residents, and unless an agreement is arrived at, there will not be an electric road between Lewiston and Youngstown this summer. It was generally understood that the company would light the streets on their line from their trolley poles, but it has decided not to do so.

Personal Notes.

MR. R. J. M. DANLEY, Columbus, Ohio, superintendent of telegraphs of the Columbus, Shawnee and Hocking Railroad since its organization, has resigned and will hereafter devote his entire time to electrical work, and open an office in Columbus. Mr. Danley is the inventor among other things of an improved repeating transmitter, and of a highway crossing alarm.

MR. JOHN WALKER, one of the founders of the Walker Manufacturing Company, Cleveland, Ohio, has withdrawn from its active management, still retaining his financial interest, however. Mr. Frank Billings was elected to the office of vice president, left vacant by the withdrawal of Mr. Walker. There was no change in the other officers, who are as follows: J. B. Perkins, president; W. H. Bone, manager, and Z. M. Hubbell, secretary and treasurer.

HOUSTON AND KENNELLY.—It will doubtless surprise many of our readers to learn that two gentlemen well known in the electrical field have determined to sever the connections they have held for so long in their respective avocations. We allude to Edwin J. Houston, president of the American Institute of Electrical Engineers, recently professor of physical geography and natural philosophy in the Central High School of Philadelphia, which chair he has just resigned after holding it for the past twenty-six years; and A. E. Kennelly, now one of the vice presidents of the American Institute of Electrical Engineers, who during the past six years has been Mr. Edison's right-hand man and chief electrician of the Edison laboratory. These gentlemen have decided to establish in Philadelphia a firm of electrical experts, to be known as Houston & Kennelly, and it is needless to say that they will be most cordially received in the field they are about to enter, not only on account of the general recognition of their eminent professional ability, but also from the high appreciation in which their personal qualities are held. Prof. Houston has been so prominently before the public for more than a decade and a half, and Mr. Kennelly in more recent years has so firmly established his professional reputation, that any extended reference to the work of either is unnecessary. Prof. Houston's connection with the Thomson-Houston company in the days when the apparatus was designed which gave it a world-wide reputation is best known, but in later years his attention to the problems of electricity has not slackened, and the public will now have the practical benefit of the wide studies he has made during this later period, besides the experience gained in earlier days. While Mr. Kennelly is perhaps best known generally from his advanced theoretical researches, which have placed him in the highest rank of electrical scientists, his practical work has been none the less valuable. His experimental researches on the heating limits of electrical conductors have formed the basis of all underwriters' rules on this subject, not only in the United States, but in Europe, while in invention his volt and ampere meters and apparatus for determining the permeability of iron take a high rank among measuring instruments. Another qualification is his thorough knowledge of the principles of alternating and multiphase currents, in which respect Mr. Kennelly has few rivals in any country. With the professional, mental and social equipment possessed by these gentlemen, there can be no doubt as to the value of their services to the public in their new capacity, and, consequently, of the success of the new firm.



Miscellaneous Notes.

ELKTON, MD., asks for proposals for a fire alarm register for an engine house and 50 signal bells for firemen's houses. Address C. R. Maxwell.

THE WADDELL-ENTZ COMPANY, Bridgeport, Conn., has passed into the hands of a receiver, Mr. Montgomery having been appointed temporary receiver on Feb. 10. We are informed by an official of the company that the embarrassment is only temporary and due to the general business depression and difficulty of making collections. The Second avenue storage battery experiment will not be affected.

MR. JOSEPH SACHS read an interesting paper before the New York Electrical Society on Feb. 15 on "Electrical Canal Propulsion, with Special Reference to the Erie Canal." After describing the various plans proposed and discussing the conditions of the problem, Mr. Sachs favored a haulage plan with an electric motor on a light track on the bank of the canal, each boat to have its own hauling motor. He estimates that such a system could be installed for $4,500,000, and operated for $800,000 annually.

M. J. FRANCISCO, of Rutland, Vt., is battling with the city authorities and a rival company, which recently was given the contract for city lighting that before was done by the Rutland Electric Company, of which Mr. Francisco is president. In a recent letter to a local paper he charges that the lines of the rival company have been constructed in the most outrageous and lawless manner, and that they purposely made "crosses" with the lines of the older company in order to destroy its machinery. In conclusion, he intimates that "boodle" influenced the award of the contract.

Trade and Industrial Notes

M. E. BLASIER & CO., 9 Charlotte street, Utica, N. Y., have issued a circular describing some of the many electric fixtures and brackets they manufacture.

THE BUSHNELL MANUFACTURING COMPANY, of Easton, Pa., maker of car seats, will increase its capital from $50,000 to $100,000 and double its force.

H. WHITFORD JONES, electrical contractor, of Cleveland, Ohio, has secured the contract for wiring and switchboard work for 1,000 lights in the new Permanent Block on Euclid avenue.

THE FIBRONE-TERRALOID COMPANY, Newark, N. J., has placed on the market a Bell receiver telephone case, which has the exact appearance of the regulation rubber, but can be sold at a much less price.

THE CRESCENT ELECTRIC COMPANY, of Lancaster, Pa., has issued a handsome cloth bound catalogue of its high-grade electric fans, in which are described and illustrated the neat and efficient ceiling, column and other combination fans and motors made by it.

THE GOUBERT MANUFACTURING COMPANY has opened a branch office at 403 Lewis Building, Pittsburgh, Pa., which will be in charge of Mr. J. H. Harrison. A full line of the Goubert feed water heaters and Stratton steam separators, of which this company is the sole manufacturer, will be carried.

THE CONSOLIDATED ELECTRIC STORAGE COMPANY, 44 Broad street, New York, has issued a circular, No. 8, calling attention to the advantages of storage batteries for central stations. A list of European stations using storage batteries is given, besides much technical data of interest relating to the subject.

THE PAGE BELTING COMPANY, Concord, N. H., has issued a pamphlet entitled "After the Fair," giving a history of its exhibit at the Chicago Exposition. Views of a large number of important exhibits using Page belting are given, and the fac-similes of St. Gaudens' medal which have raised such a national commotion.

THE JOSEPH DIXON CRUCIBLE COMPANY, Jersey City, N. J., has issued a neat 16-page pamphlet, in which Walton Day gives "The History of a Lead Pencil," which will be found interesting by all and useful by many. The various processes in the manufacture of lead pencils are described, and useful information given as to the selection of various grades.

THE OHIO BRASS COMPANY, Mansfield, Ohio, is gratified by the number of requests already received for its new catalogue, which indicate that a lively interest is taken among street railway men concerning this new edition. The catalogue is now ready for distribution to the trade, and it is to the interest of every street railway man—contractor, engineer or manager, as the case may be—to supply himself with one of them.

HUEBEL & MANGER, 286 Graham street, Brooklyn, have been busy during all the dull times, and are keeping a large force of hands hustling to fill orders. The reputation that this firm has achieved for first-class, reliable goods is widespread. They employ none but first-class mechanics, as shown by their products. The bells, push buttons, switches, etc., they manufacture embody many improvements, and dealers would do well to get a copy of their new catalogue and price list, which will be of interest to them.

NALDER BROTHERS & CO., electricians and engineers, London, England, state that owing to the numerous inquiries they have had recently as to whether they have changed the constitution and address of their firm, they feel it incumbent upon them to state that there has been no change whatever, and that the partners, F. H. Nalder, H. Nalder, C. W. S. Crawley and A. Soames, who have conducted the business during the last six years, still carry it on as Nalder Brothers & Co., and that their sole place of business is at 16 Red Lion street, Clerkenwell, London, E. C., as heretofore.

MR. W. W. HESS, formerly representative of the Car Publishing Company, of Philadelphia, has resigned his position from that publication and accepted the position of general manager for the Car Equipment Company, located at 232 Carter street, of the same city. This company will handle the street railway specialties manufactured by the Allan Electric and Supply Company in addition to the Graham truck and Ajax metal for electric purposes. Mr. W. A. Barrett, Jr., is the president. Mr. Hess has a host of friends in the street railway field, and no doubt his success will be as marked in his new position as it has been in the past.

MR. T. McCOUBRAY (P. O. Box 34, New York), the inventor of the McCoubray auto-telephone system, was secretary of the National Electric Light Association during the first years of its existence and is very generally known. At the same time he was the secretary of the Baxter Electric Motor Company, having previously occupied a similar position with the Morrison Electric Works. He has since been identified with the Westinghouse company at Boston, the Crocker-Wheeler company and the Okonite company. The McCoutray auto-telephone system is claimed to be far superior in merit and appearance to other systems, though sold at a low price.

tion. It is proposed to manufacture the apparatus on a large scale in order to meet an expected large demand.

ACCUMULATOR LITIGATION.—We have received a communication from Mr. W. W. Gibbs, president of the Electric Storage Battery Company, Drexel Building, Philadelphia, Pa., in which he states that the Consolidated Storage Battery Company, controlling the Brush patents, has instituted a suit against his company, for the sole reason, he believes, of frightening intending purchasers of batteries. He further states that his company is advised by eminent experts, after a most thorough examination, that its batteries do not infringe the Brush or any other patents. Among these experts are Prof. Charles F. Chandler, of Columbia College, and Prof. George F. Barker, of the University of Pennsylvania, who distinctly state that in their opinion the chloride battery composite plate consists of tablets of chloride of lead and chloride of zinc in a frame of metal; that there is no active material in the composite plate, nor is there any material ready to become active in a secondary battery, nor is there a secondary battery, nor is there any material which is absorptive in a secondary battery; and, further, it "does not either in its use, infringe the claims of the Brush patents." Mr. Gibbs adds that his company proposes to continue making and selling its battery and to protect all users of the chloride accumulator.

Business Notice.

BATTERY CUT-OUT, CHEAP.—Sensitive, reliable, never requires attention. Gas lighting much improved by its use. Electric Supply Company, of 105 South Warren street, Syracuse, N. Y.

Illustrated Record of Electrical Patents.

U. S. PATENTS ISSUED FEB. 13, 1894.

(In charge of W. A. Rosenbaum, 177 Times Building, New York.)

481,149. ELECTRICAL CONDUCTOR; Dallas B. Hayward, Easton, Md. Application filed July 21, 1893. An electrical conductor formed of twisted or woven graphite-coated asbestos fibre, substantially as described.

514,461. ELECTRICAL SIGNAL APPARATUS; George W. Hey, Syracuse, N. Y. Application filed April 22, 1893. A circuit closer comprising in its organization the normally separated movable terminals of an electric circuit, mechanism operated by electric current pulsations for bringing the terminals into contact with each other, mechanism being automatically reset to its initial or starting point without disturbing the contact of terminals and means for separating the terminals.

514,462. ELECTRICAL APPARATUS; George W. Hey, Syracuse, N. Y. Application filed May 9, 1892. The herein described electrical apparatus, the same comprising a circuit wire, stations connected to the circuit wire, generators at each of the stations, and connections between each station and the portions of the circuit wire on opposite sides thereof for passing a current from the generators at stations through opposite sides of the circuit wire.

514,480. CUT-OUT; Herman Lemp, Lynn, Mass., assignor to the Thomson-Houston Electric Company of Connecticut. Application filed Oct. 5, 1888. The combination substantially as described of an electric lamp, a reserve lamp, an automatic cut-out mounted upon or within the first named lamp and connected to a lamp contact or terminal thereof, with which the reserve lamp is connected; an automatic switch for the first lamp normally tending to close the connection between its extreme terminals and held open by said lamp when on its support, connections from switch to the reserve lamp, and an automatic switch or current closer governed by the latter and normally tending to complete connection to the lamp terminal or contact, which is mounted upon the first named lamp and is connected to the cut-out device thereon.

514,491. ELECTRIC FIREARM; John L. McCullough, Brooklyn, N. Y. Application filed April 7, 1893. In a breech-loading firearm, the combination with the tubular loading plunger, provided with the angular cutter near its forward end, of an electric circuit, a loop forming a part of said circuit, a carrier for said loop, and means intermediate the trigger and loop carrier, whereby when the trigger is pulled the loop will be moved forward within the cutter.

514,501. ELECTRICAL ANNUNCIATOR; Charles F. Scattergood, Albany, N. Y. Application filed Nov. 3, 1893. An electric annunciator having a transmitting plate with push buttons arranged in connection therewith in concentric circles and a receiving annunciator, consisting of a plate having a series of drops or indicators, one series in circular form and the other series on the face of the plate, each push button on the transmitter plate having an electrical conductor leading to and in electrical connection with the operating mechanism of a number of drops or indicators on the receiving plate, said conductor forming an electrical circuit, in order that when a single push button is operated a number of drops will be operated indicating the number of the circle and the point on the circle of the push button operated.

514,504. CURRENT REGULATOR FOR DYNAMO-ELECTRIC MACHINES; Charles E. Scribner, Chicago, Ill., assignor to the Western Electric Company, of same place. Application filed Dec. 10, 1888. The combination with a dynamo-electric machine of an electromagnet in the main circuit thereof, a movable armature for magnet, a clutch attached to armature, a clutch rod actuated by clutch adapted when actuated to shift the brushes of dynamo-electric machine, and contact points controlled by armature to close a short circuit about electromagnet when its armature has moved through a predetermined distance.

514,505. ELECTRIC ARC LAMP; Charles E. Scribner and Ernest P. Warner, Chicago, Ill. Application filed May 27, 1890. In an electric arc lamp, the combination with a series magnet, supported upon the frame of the lamp, of a magnet connected in shunt of the arc, supported upon a movable frame, said movable frame carrying the armature of the series magnet, whereby said frame may be raised, a clutch connected with the armature of the shunt magnet and adapted to be actuated thereby, a feeding board adapted to move with the frame carrying the shunt magnet whereby the clutch may be actuated by the shunt magnet along and not by any differential action of the shunt and series magnets.

514,506. ELECTRIC ARC LAMP; Charles E. Scribner, Chicago, Ill. Application filed Aug. 1, 1891. Two electric lamps, each having a lifting magnet and a pair of carbons, and each having a feeding magnet in shunt around both the carbons, of circuits connecting the lifting magnets in series and the pairs of carbons in multiple with each other and in series with said lifting magnets.

514,524. INFLUENCE MACHINE; Harry Fuller Waite, New York, N. Y. Application filed Oct. 28, 1893. In a device adapted to be used with influence machines, the combination with the case, the condensers therein and connections with the condensers of electrodes movable with relation to each other, and means outside of the case for moving the electrodes.

514,561. ELECTRIC RAILWAY; P. W. Leffler, Minneapolis, Minn. Application filed May 13, 1893. The combination with a car of field magnets in the line of travel, a non-rotating armature on the car, electric connections for the field and armature magnets and an automatic rotary pole changer carried by the car, located in connections to the armature magnets and operated by the field magnets.

514,566. ELECTRIC RAILWAY CROSSING SIGNAL; Michael J. O'Sullivan, Baltimore, Md. Application filed May 22, 1893. In a railway crossing signal a supporting post having a lamp at the upper end thereof, arms or paddles connected thereto, a gong secured to such support, two circuits, one containing therein a relay battery and track connections and the other a suitable motor for operating such arms or paddles and bell, and suitable connections, whereby when the train is in the section where the crossing signal is located the arms will be vibrated and the gong sounded continuously.

514,580. APPARATUS FOR TESTING THE RESISTANCE OF CONDUCTORS OF ELECTRICITY; Elmer G. Willyoung, Philadelphia, Pa. Application filed June 26, 1893. In an apparatus of the class described a variable resistance block, consisting of a pair of plates connected in series, a series of conductors of graduated resistance connected with one of said plates and adapted to be also connected with the other.

514,581. ELECTRICAL MEASURING INSTRUMENT; Elmer G. Willyoung, Philadelphia, Pa. Application filed Oct. 13, 1893. A casing, two of the opposite sides or faces of which contain panels of quartz or glass, and are respectively provided with a pair of adjacent quadrants, adapted, when the casing is closed, to be assembled in their appropriate relationship.

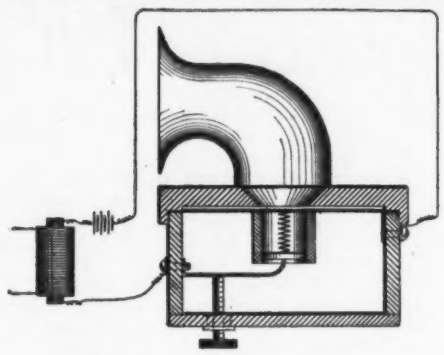
514,582. ELECTRICAL MEASURING INSTRUMENT; Elmer G. Willyoung and Madison M. Garver, Philadelphia, Pa. Application filed Oct. 13, 1893. In a measuring instrument for measuring electrical currents in combination, a working wire through which a current is caused to pass, a pointer connected with said wire, a plurality of compensating wires each substantially identical with the working wire, and a spiral spring support for maintaining all of the wires under tension.

514,583. ELECTRIC ARC LAMP; John E. Woolverton, New York, N. Y. Application filed Sept. 22, 1892. In an arc lamp the combination of a pair of converging rods, one at least of which is an arcing electrode, and a corresponding arcing electrode with means for equalizing the feed of the pair of rods comprising a pair of lazy tongs mechanically connected therewith.

514,584. GARMENT HOOK; Richard Ahlers, Brooklyn, N. Y. Application filed Dec. 9, 1893. The combination of a perforated case with a perforated face plate, a movable garment hook having a headed upper end, an encircling spring, a pair of contact springs, and an electric circuit embracing a switch and alarm and connected to said springs.

514,593. ELECTRICAL MEASURING INSTRUMENT; Elmer G. Willyoung and Madison M. Garver, Philadelphia, Pa. Application filed Oct. 13, 1893. In a measuring instrument for measuring electrical currents, in combination with the case of an electric measuring instrument for measuring electrical currents, a chamber for an extra resistance, mounted upon the exterior of the case, composed of metal plates, and formed with a central flue, which serves as a core for the resistance coil and as a means for carrying off its heat.

514,641. ELECTRIC PENDULUM CLOCK; Henri Campiche, Geneva, Switzerland. Application filed July 28, 1893. The combination of a pendulum and an electric circuit connecting an electric source with an electric clock, with an electromagnet, and a device for interrupting the circuit, consisting of a contact fork and a device which acts temporarily upon the said interrupter of the circuit so as to close the circuit after a certain number of vibrations of the pendulum, the armature of the electromagnet so



NO. 514,695.—TELEPHONE.

arranged as to give a mechanical impulse to the pendulum each time the electric circuit is closed and the jump of the hands of the clocks produced.

514,647. CIGAR TIP CUTTER AND LIGHTER; W. E. Duthie, Indianapolis, Ind. Application filed Dec. 8, 1893. The combination of a perforated base plate, a torch holder adapted to rotate thereon, a knife secured thereto and arranged to traverse the perforation, and lighting mechanism in the path of the torch.

514,651. ELECTRIC CIGAR LIGHTER; A. J. Graydon, Indianapolis, Ind. Application filed March 6, 1893. The combination of a series of batteries and an induction coil in a casing, which also carries small receptacles of oil adapted to be ignited by an electric spark.

514,686. ELECTRIC ANNUNCIATOR; I. E. Rickey, Oakland, Cal. Application filed May 10, 1893. The combination with a drop plate having a swinging ball and armature pivoted below the plate, a magnet located at the rear of the armature and means for electrically resetting the drop plate.

514,695. TELEPHONE; C. T. Bloomer, New York, N. Y. Application filed May 9, 1893. The combination of a diaphragm, a conducting fluid included in the circuit of the transmitter, a flexible strip mechanically connected at one end with the diaphragm, suitably supported at its other end and immersed in the fluid. (See illustration.)

514,697. ELECTRIC ALARM FOR PRESSURE GAUGES; W. H. Bradt, Troy, N. Y. Application filed Nov. 22, 1893. A gauge having electrodes adapted to be brought in contact by the movement of an index-operating mechanism, a lever fulcrumed on the casement wall of the gauge and engageable with the index-operating mechanism and an operating handle on the lever.

514,714. BOND WIRE FOR ELECTRIC CONDUCTORS; A. Hoffmann and J. Brogan, Milwaukee, Wis. Application filed July 5, 1893. A bond wire having bent ends and washers provided with concentric apertures for the admission of the bent ends, and with radial grooves for the admission of the portions of the wire next to the angles therein.

514,718. ELECTRIC RAILWAY SYSTEM; P. W. Leffler, Minneapolis, Minn. Application filed Nov. 22, 1893. The combination of a magnetic field extending along the line of travel, an armature and local battery on the car, and a reversing device in the armature circuit.

514,739. INCANDESCENT ELECTRIC LAMP; G. H. W. Timbrell and J. C. Fyfe, Denver, Col. Application filed Sept. 18, 1891. An incandescent lamp provided with a transparent tube projecting into the vacuum bulb and exteriorly sealed thereto, the wires leading to the filament being carried there through and sealed therein in combination with a detachable lamp holder provided with a reflecting rod adapted to enter the transparent tube and engage one of the leading wires, and suitable switch mechanism connected with the rod and located in the circuit of the lamp. (See illustration.)

514,746. APPARATUS FOR PERIODICALLY COMPLETING AND INTERRUPTING ELECTRIC CIRCUITS; E. L. Berru and F. Harrison, London, England. Application filed Oct. 6, 1893. The combination of a time keeper provided with contacts to maintain a shunt circuit closed for any determined time and a clockwork operating a circuit changer also in the shunt circuit, in which is an electromagnetic device operated at intervals to complete a circuit.

514,775. ELECTRIC ALARM; S. T. Sanders, Granite, Mont. Application filed July 29, 1893. This consists of an insulated slide connected with mine gallery chair operating-mechanism, conductors on the slide and a circuit-closing arm on the cage adapted to engage with the conductors on the slide.

514,801. TROLLEY; J. A. Williams, Altoona, Pa. Application filed Oct. 7, 1893. The combination of a hanger having bifurcated arms curved inwardly, removable shaft blocks seated in sockets of the bifurcated members, and a trolley wheel shaft keyed to the blocks and to integral positions of the hanger.

514,813. ELECTRIC CLOCK; R. V. Cheatham, Louisville, Ky. Application filed Feb. 7, 1893. This comprises a spindle arm secured to the knob spindle and adapted to actuate the door bolt, a spring secured on the arm and a lever pressed by the spring and adapted to lock the door bolt.

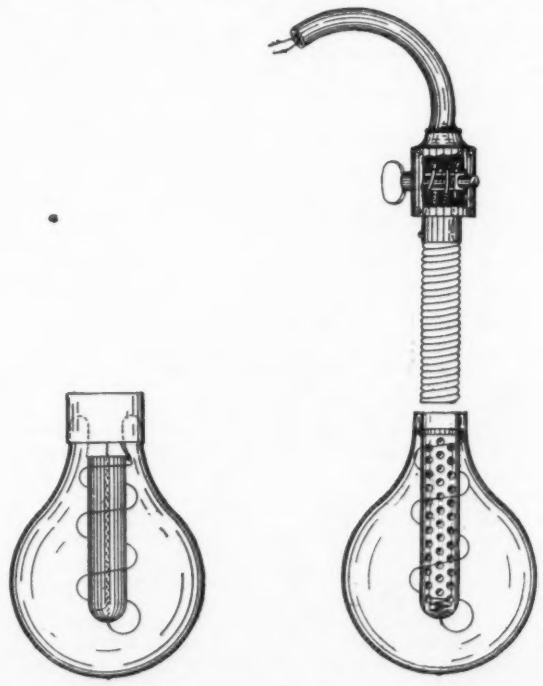
514,817. ARMATURE CONNECTION FOR DYNAMOS; O. Dufault, Spencer, Mass. Application filed Oct. 27, 1893. The combination with a commutator bar having a grooved arm provided with a dowel hole of an L-shaped conductor fitted to the groove in the end of the arm and provided with a dowel formed on the end of the lead.

514,822. INSULATING JOINT; E. F. Gennert, Brooklyn, N. Y. Application filed Aug. 10, 1893. This comprises two flanged sections in combination with a collar, which is spun over the flanges and which alone holds itself in place and the sections together.

514,823. TELEPHONE SIGNALING SYSTEM; W. Gillete, New York, N. Y. Application filed July 13, 1893. This comprises a main circuit and battery, a local circuit and battery, an alarm in the local circuit, a receiver and transmitter of a switch for shifting the main circuit from the alarm to the receiver and for shifting the local circuit from the alarm to the transmitter.

514,827. ELECTRIC RAILWAY CONDUIT. R. I. Hampton, Athens, Ga. Application filed May 25, 1893. This comprises a trolley rail chamber, a drain below the chamber, and a cable way located at the side of the rail and provided with removable rack bars superimposed transversely in the cable way to support and hold apart the cables.

514,845. ELECTRIC BATTERY CELL; P. C. Burns, Peru, Ind. Application filed June 12, 1893. In a battery cell, a carbon ele-



NO. 514,739.—INCANDESCENT ELECTRIC LAMP.

ment having grooves in which are plugs of insulating material projecting beyond the surface of the carbon element.

514,849. ELECTRIC CABLE; T. Guilleaume, Cologne, Germany. Application filed March 27, 1893. A crimped cable cylinder of non-conducting material having spiral grooves or air channels, in which naked conductors may lie.

514,878. ELECTRICALLY OPERATED STREET INDICATOR FOR CARS; H. C. Barker, St. Louis, Mo. Application filed June 23, 1893. The combination of an indicator carried by the car, a cam block on the conductor, a trolley arm having a contact piece, and a contact point mounted on the car having electrical connection with the indicator, whereby when the trolley engages the cam the indicator is operated.

514,586. ELECTRICAL TRANSMISSION OF POWER; C. S. Bradley, Yonkers, N. Y. Application filed June 23, 1890. The combination of a continuous current generator, a phasing device electrically connected therewith for converting the continuous current into alternating currents of differential phase, an electric motor, the field magnet of which is charged by a continuous current, and the armature of which is charged by the alternating currents of differential phase.